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LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. 4. SUBSCRIPTION RATES. Postage Free: United Kingdom, £1 14s. 8d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie, Etrangère, 22, Rue de la Banque.
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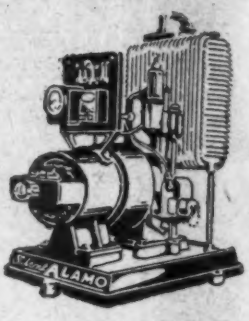

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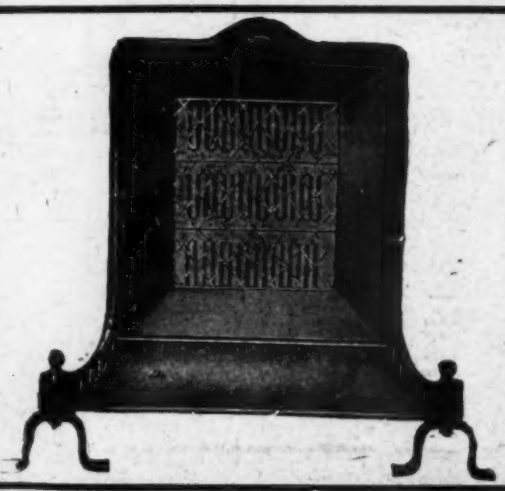

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THE

ELECTRICAL REVIEW.

VOL. LXXXVIII. APRIL 22, 1921. No. 2,265.

ELECTRICAL REVIEW.

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CANADA	1 12 6 do.
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DIVIDED COUNSELS.

WITH the sudden decision of the railwaymen and transport workers to withdraw their active support from their allies and to abandon their intention to bring about a "general strike" on Friday last, the crisis of the situation was passed. Various reasons have been assigned for their action, none of which, in all probability, was the only factor involved. The excuse officially put forward was that the miners ought to have agreed to reopen negotiations, on the lines accepted by their spokesman, Mr. Hodges, and this was undoubtedly true; but the discovery that half the members of the railway and transport unions would ignore the call as certainly exerted a powerful influence upon the attitude of their leaders, who perceived that a gigantic fiasco was imminent and hastily chose what was, from their point of view, the lesser evil, but was in fact, to the nation as a whole, an unmixed good. Once the strike had commenced it would have been tenfold as difficult to call a halt, and immense injury would have been inflicted upon the nation's interests both at home and abroad—while the remoter consequences might have been of the utmost gravity.

The leaders of the miners' allies showed a remarkable and lamentable dullness of perception if indeed they failed to realise what was common knowledge outside their councils—that striking with the object of compelling Parliament to grant a subsidy to others was a highly unpopular proposition, both from a constitutional and from a personal point of view. No one will accuse the railwaymen and transport workers of deliberate disloyalty or of a desire to upset the constitution, and the former, at any rate, at present are not nursing any grievance on the score of wages; hence the proposal to strike—on altruistic grounds—was distasteful to them. To strike in the face of public opinion and with their own followers half-hearted would have been to court defeat, and once more discretion proved the better part of valour. Will they not now learn that, sweet as it may seem to wield unfettered power, it were far better for them to submit such weighty issues to the secret ballot, and thus obtain the true opinion of their members before committing themselves to drastic action?

The forces of sedition have received a set-back which will long continue to cripple their activities, and all immediate danger of revolutionary movements has been dispelled by the common sense in the mass for which this nation is distinguished. But there still remains the great coal strike, which has now lasted three weeks, and already has caused widespread misery and privation, besides producing unemployment in many industries and threatening quickly to involve others. Ostensibly a dispute about wages, it is really nothing of the sort; the miners' representatives have steadily refused to discuss the question of wages, with the one exception of Mr. Hodges, whose resignation has been called for as the result of his action. The strike is mainly a political move, intended to force the Government to adopt a policy

which is blatantly unwise and contrary to the national interests. But the political cause is lost beyond redemption, and it now remains only for the miners to do that which they should have done at first—to enter into a discussion of ways and means to make the best of the economic situation in which they find their industry. Why that once thriving industry has fallen on evil days we are not concerned to discuss, though we think a comparison between the output per man in 1913 and in 1920 would shed much light upon the question; but we are sure that no one in this country would willingly see the miner compelled to accept a standard of living lower than the highest that the industry can bear. To suppose that as a result of the war the standard of living in any grade of the community can be permanently raised is to trifle with the teachings of the most elementary common sense—after spending 8,000 millions sterling on unproductive objects the nation must necessarily be impoverished for years to come; but we are by no means the worst sufferers from the war, and if our people would only put their backs into their work and PRODUCE as abundantly and as cheaply as they could, we should soon recover our position and our national prosperity.

As reported in our last issue, the London branch of the Electrical Trades Union decided to take part in the intended general strike. The Electrical Power Engineers' Association, on the other hand, took a serious view of its obligations and responsibilities in the national emergency, and resolved to continue at work, in order to maintain the public supply of electricity. These decisions are in agreement with our anticipations.

The Industrial Situation.

Now is the time, in our opinion, for a broad and generous settlement between the coal miners and coal owners. So far neither help nor benefit has come from Government interference, and we venture to submit that the problem is eminently one for settlement within the industry itself.

The provision of an abundant supply of cheap fuel is perhaps of more importance to our industry than to any other, and is the foundation of all progress towards that flood of electrical power which was not long ago one of the main planks of the reconstruction programme.

It was, of course, notorious that the Government was making immense profits out of the export coal trade, and this fact, no doubt, was contributory to the "ca' canny" humour of the miners. It is also believed in many quarters that the owners were not anxious to exploit their best seams or to secure the highest possible profits so long as these profits were taken by the Government. The time has now arrived when the industry must stand upon its own feet, and the issue as between owners and miners really narrows down to a question of minimum wages.

In this matter we cannot withhold a word of sympathy for one phase of the miners' proposals. As a united body, representing practically all the workers in the coal mines, they point to the injustice which is involved when a man working upright in a six-foot seam receives the same price per ton, or proportionally a very much higher wage per diem, than the man who is working bent double in a seam three or four feet thick. Their proposal is that the fortunate mines in which coal is easy to get should contribute out of the wages paid to the miners, and out of the profits which the owners eventually hope to secure, to a pool which should be used to provide a minimum reasonable wage for miners in the poorer mines, or in less fortunate positions. On the face of it this appears to be a just and even generous proposition on the part of the miners, and one which could be carried into effect without seriously interfering with the natural variations in rates of profit as between mine and mine.

We quite agree with the Government contention that anything which would bring back, or tend to bring back, Government control would be an unmitigated curse, and that nothing should be done to destroy the incentive on the part of the owners to produce as much coal and profit as possible, and on the part of the miners to increase the output to the greatest possible extent. We have no doubt that, given favourable conditions, owners would soon be found doing their utmost to provide electrical and other equipment to ensure the greatest possible output per man, and on the part of the miners if a reasonable wage and satisfactory conditions of living could be arranged for every man in the industry, they, on their side, might be induced to return to their pre-war activity and output. Whether a restoration of the eight-hour day is possible is a matter for discussion.

We venture to suggest that owners and miners should get together as quickly as possible under the chairmanship of some able and impartial man, than whom no better could be found than Sir Arthur Duckham, K.C.B., and that they should proceed to set their house in order, without giving the opportunity for further outside interference or internal embitterment. The struggle has already lasted far too long, and the interests of the whole nation call for a prompt, generous, and permanent settlement.

French Enterprise in Germany.

One of the most extraordinary facts in connection with the French occupation of the district of the Saar is the inexplicable interest manifested by French financial and industrial companies in German iron and steel and engineering undertakings in that district, in which they are reputed to hold 60 per cent. of the total capital, and to these participations has now to be added a scheme for the French control of the Homburg generating station belonging to the Pfalz (Palatinate) Works Co., of Ludwigshafen. This station, which supplies a considerable part of the Rhenish Palatinate with light and power, is dependent upon the delivery of Saar coal for generating purposes, as Ruhr coal is unobtainable in sufficient quantities, and at the same time is too costly on account of the high transport expenses. It is now proposed to transfer the Homburg station to a new company having an ordinary share capital of 30,000,000 marks, and loan issues of 70,000,000 marks. Sixty per cent. of the combined capital and loans is, it is said, to be taken over by the Compagnie Générale d'Electricité of Paris, the French Thomson-Houston Co., and the Schneider Co. of Creusot, while the balance will be held by German interests. Before the war there were many instances of friendly co-operation between French and German industrial interests. This question, however, does not come into consideration in connection with the requisition of 60 per cent. of the financial interests in Saar iron and steel and engineering works or the proposed absorption of 60 per cent. of the capital in the Homburg generating station. The key to the position—it is well to speak plainly—lies in the French State possession of the Saar coal mines, as it appears from the Versailles Treaty, in perpetunity; coal is the lever which has given the French the great hold on the Saar works, and coal is again the lure in the case of the Homburg electricity works. It is easy to understand the desire of the French authorities to obtain permanent markets for Saar coal in face of the present impossibility of doing so, or of even keeping the miners on full working shifts. On the other hand, the idea cannot readily be dismissed from consideration that French industrial interests would have been better occupied in developing their own resources and those in redeemed Lorraine, rather than in extending their sphere of activity to works in

the Saar and beyond, because it is a foregone conclusion that the Saar region must remain German property, as the Treaty provides that when the plebiscite takes place 15 years from ratification, only those resident in the district of the Saar at the date of the signature of the Treaty will be entitled to record their votes.

The Electricity (Supply) Bill.

According to the daily Press, some 50 Members of Parliament have given notice to move the rejection of the Electricity (Supply) Bill introduced by Sir Eric Geddes, on the second reading. As it is the desire of the Government to avoid contentious legislation during this session, there is reason to fear that the Bill may not be passed, in which case the work of the Electricity Commissioners will be sadly hampered. So far as a cursory examination reveals, the contents of the Bill are identical in every respect with those of the Bill introduced at the end of last session and reviewed in our issues of December 24th and 31st, 1920.

The Building Trades Exhibition.

It had been understood that, in electrical circles at least, it was strongly held that all new buildings should be wired for an electricity supply, and that wherever the least possibility of success was apparent no effort should be spared to bring about this, from every point of view, desirable consummation. Moreover, it is obvious that an exhibition organised by the building trades is the place for exhibits illustrative of wiring systems and all kinds of domestic electrical apparatus.

With the above-mentioned considerations in mind, a visit was paid to the Building Trades Exhibition, now in progress at Olympia, in confident anticipation that such an exceptional opportunity of enlisting the interest and sympathy of all connected with housing and the building trade in the subject of "electricity in the home," and the innumerable benefits and economies that are bound to result from the use of electricity, not only for lighting, but also for cooking, heating, and power, would have been fully utilised by the electrical interests concerned.

Alas! what does the visitor find? Out of some 295 stands about a dozen of more or less electrical interest (with the emphasis on less), and only four or five of those that could by any stretch of imagination be described as "all electric" ones. One stand devoted to cooking and heating devices—not a single exhibit of installation materials or wiring systems; not one of lighting fittings!

What a record! Worse even than that of last year, and a truly disheartening one. While the gas interests are on every occasion conspicuously in evidence, electricity is relegated to the background—and with what effect? The visitor notices the absence of electrical exhibits and draws his own conclusion. We can only hope it will be a charitable conclusion, but assumptions are dangerous.

When will the electrical people cease hibernating, and bestir themselves from their torpid state to the realisation of the fact that they need publicity, and that to obtain it they must seek it, in the right way, and at the opportune moment?

The E.T.B.I.

On Monday next the annual general meeting of the Electrical Trades Benevolent Institution will take place. It is not usually an occasion for "standing room only"; in fact, it must be regretfully confessed that the attendance is generally meagre. Is it pressure of work, counter-attractions, or lack of interest that keeps the members away?

This is a very necessary and wholly laudable institution, whose sole purpose is the intensely human, but divinely inspired motive that is instilled by the story of "the good Samaritan"; but in this case the victims of misfortune are of our own nationality and of our own profession—hence their cause should appeal to us even more urgently. May we not hope that some of the supporters of the Institution will make it their business to step aside for an hour and give the benefit of their advice to the Committee of Management, and make themselves acquainted at first hand with the affairs and the work of the Institution? Their presence will be most welcome, and the evidence of their personal interest will hearten the Committee, and encourage its members to greater efforts. There is nothing so depressing as indifference—active hostility would be a powerful stimulant, but cordial support, after all, is the very best spur.

The Romance of the Turbine.

The classic paper read before the Institution of Electrical Engineers by Mr. K. Baumann should prove a "landmark" in the development of the steam turbine. It is a mine of information on present-day theory and practice, and though in some respects it lacks completeness, the author cannot be reproached on that account; the 59 pages are closely packed with matter of the highest interest and value, and papers read before Institutions are not intended to be exhaustive treatises. The Institution is to be congratulated on securing, for the second time, so useful a contribution from this author.

The history of the steam turbine is an engineering romance. We well remember seeing one of the earliest of Sir Charles Parsons's machines at the Glasgow Exhibition of 1888, mounted on a stand about the size of an office desk, and running at a speed of something like 10,000 revolutions per minute. The attitude of the Clydeside engineers towards the little spinner was highly charged with scepticism, if not open disapproval. They gave it the opprobrious title of "steam-eater," and it was, in fact, regarded as little less wasteful than an open pipe through which the steam could blow at will. The Clyde built monster vertical marine engines towering 40 feet above their bedplates, which looked down upon their tiny rival as an elephant might regard a mouse, with dignified toleration. But what a change has taken place since then—how are the mighty fallen! Clydeside has built steam turbines of the largest size, and the giant quadruple expansion engine has followed the beam engine into the limbo of the past, together with the huge flywheel alternator.

With all due deference to Hero of Alexandria, De Laval was the first to build a practicable turbine, of the impulse type; but it was Parsons that doggedly persevered with the development of the machine, on the reaction principle, in the face of countless difficulties, and established its position as the premier heat engine for large powers—an achievement by which for all time he has crowned British engineering with glory. Splendid work has been done abroad, but Parsons hewed the track to success. In the early 'nineties we saw his machines supplying part of Newcastle-upon-Tyne with electricity; in 1899 we went to see his 1,000-kW sets destined for Elberfeld, which marked the opening of a new era in the history of the turbine; and in 1913 we recorded the dispatch of his 25,000-kW set to Chicago, which set the seal on his success. It is a proud record. In 1892 a 200-h.p. Parsons turbo-alternator consumed 27 lb. of steam per kWh, "thus rivalling the performances of the best compound condensing reciprocating engines." In 1900 the Elberfeld 1,000-kW set consumed 20¼ lb. per kWh; and in 1913 the 25,000-kW set consumed 11⅛ lb., a result within 0.6 lb. of the best recorded in Table 22 of Mr. Baumann's paper. According to the *Electrical World*, the total steam power equipment installed in the United States in 1920 was 11½ million h.p., of which 15½ per cent. was credited to reciprocating engines, and no less than 84½ per cent. to steam turbines; in 1907 only 1¾ million h.p. was installed, of which 44 per cent. was provided by turbines. Thus the reciprocating engine practically reached its limit 14 years ago, while the turbine accounts for almost the whole of the additional power installed since that time.

D

THE FINAL ADJUSTMENT OF PRECISION INDUCTANCES.

By G. E. MOORE.

General Considerations.—This is a subject about which there is little definite published information. There are, of course, several methods adopted by makers of inductances and by experimentalists for the attainment of high accuracy, and in the following article the writer has endeavoured to present several examples of these. The inductances referred to are of the ironless type, and of fixed value; both self and mutual inductances are dealt with. The information contained herein will, it is hoped, prove generally useful, but particularly so to workers in electrical test-rooms and laboratories.

An inductance is invariably made up with some form of fixed support, this, as a rule, being the convenient bobbin. If precision is not desired, and a mere approximate or round-figure value suffices, then the natural thing to do is to adjust to one turn. With a high self-inductance—say, of one henry, which can be attained with about 2,350 turns and a mean diameter of 15 cm.—it is possible to reach an accuracy of 0.1 per cent. or even 0.02 per cent. with one-turn adjustment; with low values (say, of less than 100 millihenries); adjustment to one turn is useless for precision work. This can readily be understood when it is remembered that self-inductance is proportional to (No. of turns)^2; [the reciprocal of (No. turns)^2] × value of the self-inductance roughly gives the one-turn value, this being relatively much greater for low than for high self-inductances.

In the case of mutual inductances, where, if you double the turns of one component winding you double the m.i. value, one turn represents a definitely important amount.

Whatever the inductance may be, the calculated value must be checked by actual test; with high values and the application of a really reliable formula, quite good results are obtainable, especially as one- or two-turn adjustment suffices, but in low values calculation cannot be so fully relied upon, and the check-test (as well as adjustment to other than one-turn accuracy) becomes imperative. Under most working conditions, however, it is found that, whatever the size of inductance, the calculated value is to be regarded as an approximate stipulation only, finality as regards number of complete turns and part-turn being decided on test.

If consistent precision is required, an open coil without any really solid support should be deprecated. It is quite possible—in fact, easy—to adjust such an inductance very accurately; but when eventual working conditions are taken into consideration such construction must be abandoned, unless the inductance is merely required for brief experimental purposes. Temperature effects (including heating from the air and by accidental overloads), inherent changes, and possible rough treatment preclude the adoption of such form for prolonged use.

A solidly confined coil, then, is imperative. The support which appeals most from the point of view of convenience in manufacture is the round bobbin form with a square-cut slot; other kinds are met with, including the rectangular former type, but the bobbin is universally favoured and, in the practical details which follow, this is the form treated. Most of the directions, however, are not applicable *solely* to the bobbin coil.

The most effective material for the bobbin is marble, and it is used for standards, but Cuba mahogany and similar hard woods thoroughly seasoned and impregnated, are good substitutes. Insulating materials and fixing media should be of reliable quality, non-hygroscopic, and of such nature as to set rigidly. Drying-out in vacuo is a wise precaution. In practice, such steps as the latter and polishing of the wood, &c., should be carried out before actually beginning the final adjustment; in this case it is advisable to adjust roughly and leave on an excess number of turns, preferably protecting the exposed layer. Finality of adjustment can afterwards be safely undertaken.

When this latter stage is reached several alternative methods whereby precision is secured are possible. Conditions will determine which is the best. For example, the size and construction of a given bobbin, and particularly the position of its terminals, will point to whichever method is applicable; on the other hand, it may be feasible to make the bobbin to suit a particular method.

I. *Self-inductances.*—At first thought the obvious course in lieu of the one-turn is to start the last turn and to return before completing it—keeping the outgoing and the incoming wires apart. Except in single- and perhaps two-layer inductances the effect is negligible,

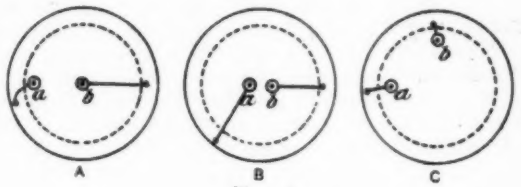


Fig. 1.

and even in the case of the exceptions this ruse is of little real use; this is also the result with the artifice of winding on a last turn of curly form. The practical alternatives now set forth are classified as far as possible:—

(*a*) The position of the terminals is important. In fig. 1 are shown three simple alternatives wherein the terminals are disposed on the flat of one cheek. The left illustration shows a very convenient method whereby the last turn is finished exactly where the required precision value is reached, and the terminal *a* placed to suit; this arrangement is apt to cause trouble with the outside leads. The second illustration (B) shows the two terminals *a* and *b* located in the centre of the cheek. In both of these alternatives the short lengths of wire on the cheek should preferably be sunk into the latter.

The terminals may both be placed near the periphery of the cheek, as in fig. 1 C; this plan suffers from the disadvantage of arrangement A. In fig. 2 the terminals are shown close together, in one case being near the

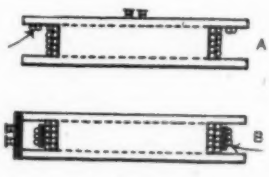


Fig. 2.

cheek edge, and in the other on the bridge of ebonite or the like—a design which has certain advantages. The terminal connections from the winding can be disposed as in fig. 3 A, but a better alternative is finally to adjust in the winding slot itself. If one or more turns on the last layer are wound *with a greater diameter than that of the latter* the self-inductance can be reduced. This can be carried out by placing the adjusting turn(s) on the inside of one cheek, as shown by the arrow in fig. 2 A. A more convenient alternative is to separate the turns from the last layer by a suitable number of windings of insulating strip, or to run a length of sleeving on the said turns of wire. Provided there has been an excess number of turns to start with there should be no need to solder on an extra length of wire.

(*b*) A crude, but, so far as regards ease of adjustment, effective arrangement is to place the last layer on the outside of one cheek (*vide* fig. 3B), connection being made to the terminals; the shape and position of the loop so formed are varied until satisfactory accuracy of value is obtained, cleats and hard wax or the like being applied during the operation. This method is suitable for inductance bobbins enclosed in protective cases.

(*c*) The previous device can be modified so as to sink the adjustment itself in the cheek; it is difficult to cut a suitable groove for the kind of loop referred to in (*b*), but a circular pit can be cut at the centre of the bobbin, and one or more loops placed in this, the hole afterwards being filled in and preferably covered—say, by a name-plate or terminal block.

(*d*) If the self-inductance be adjusted to one turn *under* required value the latter can be reached by connecting in series another inductance wound on a very

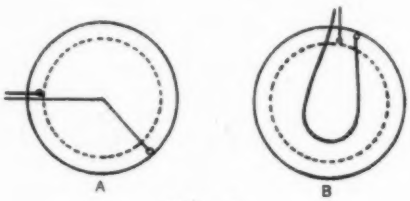


Fig. 3.

much smaller bobbin, rough accuracy on this giving the required precision on the composite inductance. Such an arrangement is conveniently carried out, but the component bobbins must not be allowed to change their relative positions; further, the existence of two fields is a source of difficulty in actual application. In a modification, the little inductance is placed in the winding slot over the main inductance. Several positions are possible, and one can place the coil non-inductively to the main coil or with the two fields opposing or assisting. Permanence of position is naturally imperative.

(*e*) In the case of solenoidal windings one can frequently have recourse to the spacing-out of a certain number of turns. This is very effective with tiny inductances. One of a microhenry, for example, can be made up with four turns of (say) 30 S.W.G. wire on a 3-cm. diameter tube, and the turns can be spaced out over a winding length of about 0.5 cm. Further, with these small values the self-inductance of the internal terminal leads can sometimes be utilised.

II. *Mutual Inductances.*—(Fixed types being presumed) the two windings may be applied concentrically in a single winding slot of one bobbin; or a bobbin with two adjacent winding slots can be utilised; or two separate single-slot bobbins may be adopted. In many ways the first-mentioned, in which the windings occupy the same mean plane, is the best. As regards precision adjustment, this is generally carried out by altering the number of turns on *one* winding only—the winding which is most accessible, particularly if one of them is to have a required value of self-inductance; both this and relative position may decide the m.i. of the two-bobbin arrangement.

In the adjustment of one winding, recourse may be had to any of the methods utilised in (*a*), (*b*), (*c*), (*d*), and (*e*) above. If one of the windings is composed of wire which is much thicker than that of the neighbouring coil, it is advisable finally to adjust, and so to predispose the windings, as to carry this out with the thinner wire.

Whilst on this particular topic it may be of interest briefly to mention the method of final adjustment used in Campbell's Variable Mutual Inductance ("V.M.I.").* In this the two *fixed* secondaries are wound with cable composed of ten sections, each section consisting of four strands of silk-covered wire. The primary and the two fixed secondaries are placed on a couple of concentric bobbins spaced out by three supporting pillars. Each of the secondaries is finally adjusted by a loop of the cable on the cheek of the outer bobbin, in the manner shown in fig. 4 A, and rigidly retained in place by cleats and wax.

Every section of a secondary cable in the "V.M.I." represents a definite value of mutual inductance, and the ten sections being connected in series, the total m.i. should equal ten times that of one section. It is sometimes very difficult in practice to make the sections precisely equal, and the author therefore introduced the "split cable" device shown in fig. 4 B. At the point *a* of the adjusting loop the cable is opened out into the ten sections and after the solid portion of the loop has been disposed to give a mean m.i. value, final adjustment is carried out by the little exposed length of each section.

Conclusion.—This article is concerned mainly with the constructional aspect of inductance adjustment, but it will not be out of place to mention briefly a few points in connection with actual measurement. Certain precautions must be observed, or the care taken in accurate adjustment will be rendered more or less useless and the precision valueless. Stress has been laid on the possible effects of inside leads in small self-inductances, external temporary leads also require consideration, for their inductance and/or capacity may militate against test accuracy. Generally the leads can be "shorted" while the test zero is determined, and this should be carried out with as little change as possible in the disposition of the leads relative to the inductance. When using a.c. for test purposes, fair constancy of frequency is essential—in some cases absolutely imperative; the writer remembers trying circumstances under which he used an inductor alternator driven by a motor, the speed of which carefully adjusted itself according to the by no means inconsiderable pressure variation of the works' mains, the set and its control gear being well out of his reach.

Stray fields and the mutual effect between the test apparatus and the inductance must be counteracted. Placing the inductance at a distance necessitates lengthy leads, and these are inadvisable. It should be turned through 180 deg. after a first reading and another then taken—the mean of these readings being accepted; in addition, the inductance under test should, so far as is possible, be placed non-inductively to the inductive

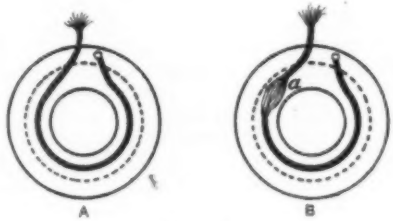


Fig. 4.

portion (if any) of the measuring apparatus, the axes being on the same plane. Mutual inductances are somewhat troublesome in this respect. In any case, stray fields and adjacent metallic articles must be avoided if possible; a glance under the test-bench sometimes proves enlightening!

The behaviour of large sub-divided self-inductances is worthy of mention, the effect of self-capacity being rather curious. Each section is wound and adjusted in turn, the terminal inductance (so to speak) having a cumulative value. On remeasuring the inductance of the first section, it is found to be no longer accurate, and, with all sections still remaining in series connection, it must be readjusted—this treatment being applied to all divisions.

In conclusion, it may be noted that an inductance can possess a temperature coefficient (percentage inductance change per degree), the value of which may or may not be erratic, and should not be serious; big temperature changes are naturally to be avoided.

* These details by kind permission of the Cambridge & Paul Instrument Co., Ltd.

DOMESTIC TARIFFS AND THE QUESTION OF CHEAP METERING.

(Communicated.)

In the Electrical Review of February 6th, 1920, there appeared a very suggestive article from the pen of Mr. C. W. Marshall entitled "The Need for a Cheap House Service Meter." In this article Mr. Marshall drew attention to the high proportion of the total cost of giving a supply to the domestic consumer represented by the cost of the meter, and dealt briefly with the possibilities of reducing this cost. The discussion following this article did not shed very much light on the problem, but mainly turned on the suitability of the shunted electrolytic type of meter. The writer of the article referred to hinted that he would at a later date publish some proposals for a solution of the problem of reducing the cost of metering the supply to domestic consumers, but, up to the present time, little of value has been written on this subject. There are one or two aspects of the metering problem that seem to have escaped general notice, and the object of the writer of this article is to endeavour to show the bearing they have on the problem of cheap metering.

The first of these points which it is proposed to develop turns on the present consensus of opinion regarding the correct method of charging for domestic supplies. Experience has shown that the old system of two flat rates, the one for lighting and the other for heating, has many disadvantages, the most important being the need for duplicate wiring and duplicate meters. For large radiators and cookers a separate wiring system will probably always be a necessity owing to the restricted size of the lighting wiring, but for small heating devices, such as irons, toasters, kettles, and so forth, the ordinary wiring would be sufficiently heavy. The impossibility of using the lighting wiring under the old tariff, except by paying for electricity used for heating purposes at the high rate, has seriously retarded the use of electricity for small heating devices. This was a grave disadvantage of the old tariff, for although the individual consumer's load factor for the energy used for such small devices may be very low, yet the diversity factor of such a load was high, and the additional units were sold with but a trifling augmentation of the maximum demand at the generating station. The use of two meters further increased the already high cost of giving the consumer a supply, and entailed a heavy expenditure on the part of the supply authority which met with but a poor return in view of the negligible margin of profit at which the heating rate was fixed.

These considerations largely tended to focus attention on the domestic contract system of charging, under which the consumer agreed to pay a fixed sum per quarter, which was intended to cover his equitable contribution to the standing costs of the undertaking, plus a charge for energy consumed for all purposes, based on the actual running cost of production. Such a system allows the full use of the ordinary lighting installation for any purpose up to its safe carrying capacity, and so encourages the use of electricity for heating purposes, and also abolishes the need for a second meter. In fixing the charge for electricity supplied for any period, there are two quantities to be measured, calculated, or estimated: The energy consumption, and the fraction of the station maximum demand to be allocated to the consumer. No really satisfactory method of determining this second quantity has yet been devised. The measurement of the maximum demand of the consumer by means of an indicator connected in series with his installation does not give an accurate solution of the problem, in that the maximum demand of the consumer does not represent the proportion of the station maximum load that should justly be allocated to him. The further factor to be taken into account is that of diversity, and this factor is one concerning which there is now considerable uncertainty, even where a well-defined class of consumer is being considered. The provision of a demand indicator, moreover, perpetuates the disadvantage of a second meter. For these reasons, efforts have been made to devise an equitable system of assessing the proportion of the standing charges to be borne by the consumer, by basing this charge upon some such easily determined figure as rateable value, connected load, number of rooms, or area of floor space.

Such methods are now well recognised, and have met with a considerable measure of success, although it is quite evident that the connection between the quantity taken as a basis and the actual fraction of the station maximum load due to the consumer's demand is not necessarily one of proportionality. The standing charge allocated to the consumer should, however, be based on the unknown demand he makes upon the station at the time of maximum load. As this cannot be measured, or determined, but only, at the best, estimated, it follows that a domestic contract system of charging can only be approximate, so far as the fixed charge per quarter is concerned. In other words, the amount payable is not proportional to the service rendered. The second portion of the charge to the consumer is proportional to the energy consumption as given by the registration of the meter. The effect of inaccuracy of the meter is interesting to consider. In the first place, it would appear that high accuracy of metering is somewhat futile when applied to the one part of the charge, when the other part is founded either on an approximate estimate, or upon some quantity that is not a function of the quantity that should fix this part. This view is perhaps hardly sound, as there is no reason why, because one part of the charge is inaccurate, the other part should not be based on as correct a measurement as possible. The most vital point to consider is the effect of inaccuracy of the meter upon the consumer's bill. When the flat rate tariff is in use, a certain inaccuracy of the meter makes a similar difference to the amount of the consumer's account. With the domestic contract system of charging this is no longer true. Where the standing charge is high and the running charge low, it is clear that for an ordinary domestic load factor a relatively large meter inaccuracy will make a very much smaller percentage difference to the total charge to the consumer. To illustrate this point a concrete case may be taken of a house supplied on the rateable value system, the standing charge being 15 per cent. of the rateable value per annum, plus 1.25d. per unit. Taking the rateable value as £40 per annum, and the electricity consumption for all purposes as 600 units per annum, the charge to the consumer will be made up as follows:—

Standing charge per annum, 15 per cent. of £40, = £6.

Running charge, 600 units at 1¼d., £3 2s. 6d.

Total charge per annum, £9 2s. 6d.

If the overall inaccuracy of the meter had been 5 per cent. slow, the energy consumption would have been registered as 570 units, and the total charge would have been diminished by 3s. 1d. The percentage error of the charge for the twelve months would then have been 1.6. The load factor of the house in question would, on the assumption that the standing charges of the electricity undertaking were £12 per annum per kW of station maximum demand, be 18.2 per cent., allowing for diversity. In the case under discussion, it is easily calculated that the meter inaccuracy may be as high as 7.3 per cent. before the percentage error of the charge to the consumer reaches 2½.

The foregoing inquiry shows that, with load factors likely to be met with for ordinary domestic consumers, the need for high meter accuracy is small where a domestic contract tariff compounded of a fixed standing charge plus a low rate per unit is in use. Not only is the standing charge payable by the consumer de-

termined by methods which are unscientific and which cannot lead to accurate results, but the effect of a certain percentage meter inaccuracy is a very much smaller percentage error in the consumer's account. This latter inaccuracy is, of course, the one that is vital. Where a flat rate tariff is in use the inaccuracies of the meter and of the consumer's account are identical, but with the domestic contract system this is not so, even with a 100 per cent. load factor. This being so, it appears that there is a case for the use of meters of inferior accuracy in connection with domestic contract tariffs, as compared with those requisite to be used in connection with the flat rate system. The sacrifice in accuracy could reasonably be expected to result in a cheaper meter being possible commercially.

The second aspect of the question of the cost of metering domestic supplies to which it is desired to draw attention is the matter of meter rents. The charge for the use of the supply meter has been condemned by many supply engineers, and several undertakings have abolished such charges. This policy seems to be an unwise one for two reasons. In the first place, the meter rent is one that most people are accustomed to pay. The charge is made by most gas supply authorities, and the custom of making such a charge is now well established. In the second place, the charge for the meter is a thoroughly scientific one, and is in conformity with the doctrine that the charge for electricity supply shall depend strictly upon the cost of giving such supply.

The commonly held view that the total charge to a consumer of electricity should be divided into two portions—the standing and the running charge portions—is an erroneous one. The division should be threefold, the three divisions being, (*a*) the running charge based upon the energy consumption, (*b*) the standing charge based upon the estimated portion of the maximum station load to be allocated to the consumer, and (*c*) the capital and other charges incidental to the consumer himself. These latter charges include the charges on the capital outlay on the service and meter, together with the cost of reading the meter, rendering the account, collecting payment, and issuing the receipt. Such charges are, or should be, if the strictly scientific basis of charging be adopted, the concern of the consumer alone, and the whole of such charges should not be pooled and divided. The possible amount of such charges can easily be calculated for an average case in present-day circumstances, as follows:—

Capital charges on service, 10 per cent. of £10, £1.

Capital charges and maintenance of meter, 15 per cent. of £4, 12s.

Reading meter, rendering account, &c., 3s. 6d.

Total per annum, £1 15s. 6d.

Strictly speaking, this charge of £1 15s. 6d. per annum should be paid by the consumer, in addition to the cost of his energy, and his proportion of the true divisible standing charges. Such a course would, of course, penalise the small consumer, for these special charges do not increase in proportion to the maximum demand or the energy consumption, and the principle of expediency has led to the practice of lumping together all consumers' charges and adding them to the standing charges to be divided in the ratio of the consumer's demands. The effect of such practice can easily be calculated for an undertaking having 6,000 consumers, and a maximum load of 10,000 kW. Taking an average consumer charge of £2 per annum to cover cases where two or more meters are installed, the total consumer charges are £12,000, or £1.2 per kW. The amount paid by a consumer with a proportion of station maximum load of 500 watts will therefore be 12s. per annum only.

According to this reasoning, it is clear that the meter rent charge is a logical one, as being a contribution towards the cost of supply applicable directly to the consumer. There appears to be little reason why meter rents should not be increased to meet the increased cost and maintenance of meters. It should be remembered that a meter rent of 2s. per quarter, or 8s. per annum, will represent a return of 10 per cent. on a capital expenditure of £4 on a meter. The meter rent can, therefore, be regarded either as the payment by the consumer of the capital charges on the meter itself or as payment of the maintenance cost of the meter. If the meter rent be retained and regarded in this way, it would appear that the relatively large outlay required to provide a meter for domestic supply is met by a direct payment by the consumer of the charges on this outlay.

The suggestion regarding the relaxation of the standard of accuracy of consumers' meters is doubtless a far-reaching one, and it would doubtless be a legal question as to how far this was permissible. It may be remembered that provided that the inaccuracy were determinable, and that the true energy consumption could be calculated by applying a suitable correcting factor to the readings of the meter, there would be little objection to the proposed step, as the inaccuracy of a meter in dispute could always be determined by connecting a high-grade meter in series for a short time. The chief point of the argument is that a relatively large inaccuracy of the supply meter can be allowed without the charge to the consumer being altered by more than 2½ per cent.

The question how far the cost of meters could be reduced by a relaxation of the requirements regarding accuracy, is one for the manufacturers. In this connection it must be borne in mind that a sacrifice of accuracy would not imply a sacrifice of reliability, and that, therefore, it would not be legitimate by cheapening the design to increase the solid friction error. A brief consideration of the various types of meter in use may serve to indicate the possibilities of a reduction in price by a sacrifice of accuracy.

The electrolytic type of meter is not likely to be used largely in connection with domestic tariffs, owing to the fact that the use of heating apparatus intended to be encouraged by these tariffs would require the use of a meter of higher rating than is usually deemed advisable with the type in question. Mercury motor meters might conceivably be simplified by diminishing the correction for fluid friction. Direct-current commutator ampere-hour meters would not appear to offer great possibilities of simplification by a sacrifice of accuracy, as experience has shown that these meters, as at present constructed, do not retain a very high standard of accuracy after having been in circuit for a few months. Alternating-current induction meters, again; appear to offer few opportunities for simplification, although the fact that a domestic load is almost invariably of approximately unity power factor would suggest that accuracy of quadrature of the pressure flux is not of great importance.

THE KINEMA ON ACTIVE SERVICE.

By F. C. DREIER.

Much is known concerning the soldier's entertainment during the war so far as regards concerts, Y.M.C.A. huts, regimental affairs, &c., but little is perhaps known of the part played by that most popular device, the kinema. The writer had some months' experience in this connection while on active service, and has set down in the following article a few brief remarks relating to kinema work in the war zone.

First, it should be pointed out that touring by road in France during the war was not comfortable, even in the most luxurious of cars, and as it was impossible except at the bases like Boulogne, &c., for the soldier to go to the "pictures," the "pictures" had to be taken to him, by means of lorries, or "mobile kinemas."

The electricity for lighting and supplying power to the projector, &c., was obtained in two ways. Some of the lorries which were used for daylight shows were fitted with a generator on brackets in the driver's cab, this being belt-driven from the lorry engine, so that room could be given inside the lorry for the projector

and operator, the pictures being thrown on a transparent screen at the rear of the vehicle. The other units, used for ordinary indoor shows, were generally fitted with a complete petrol generator set fixed inside the lorry, the picture in this case being shown as in an ordinary kinema from the front, and a solid or light resisting screen used.

Now we come to the projector (and, incidentally, some more troubles, which are not met with at home). This is a delicate piece of machinery, and must be kept in perfect working order so that such accidents as frequent film breakages, tearing of perforations, and fire, may be prevented as far as possible. This is not a very difficult matter when, as in a town kinema, the projector is fixed permanently to the floor, and needs only slight minor dismantling for cleaning purposes, but out there, we were extremely handicapped for space, and it was impossible to carry such a delicate machine inside a lorry, completely fixed up for use, as the jolting set up by the terrible condition of some of the roads would have damaged it so much as to render it unfit for use. Therefore it had to be dismantled completely, and carefully packed after each show, and sometimes—in the writer's case at least—shows were given at seven different places in one week. It will be seen, therefore, that the projector had to be re-fitted, adjusted, cleaned, and refocused for every move made, before a show could be given.

Now let us see the difference between the soldier's kinema and ours at home.

At home we could go to our "kinema de luxe," and see perfect pictures in perfect comfort. "Out there" pictures were seen at rare intervals, and when they did come, the "palace" was either the open air, or a barn, an old stable, or even a ruined building, shot-riddled from some previous attack. During hostilities also they were sometimes near enough to the line to be unpleasant. I myself have given a show under an old railway arch, and have had to "scrounge" (as we used to say) some old sand bags, canvas, and tarpaulin to fit up at both ends so that the light and also the elements might be, at least, partly shut out, and also have had to fix up something like a firm stand or flooring for the support of the projector. It was hard work, but we did not mind, and, after all, the job had its humorous side.

The films were kept in lock-up, galvanised iron boxes, and two or three programmes were carried by each unit, and when one complete tour of the circuit allotted to a unit had been made the programmes were changed at depots for that purpose, and the tour recommenced. Sometimes we have packed up at 8.30 and left one place, travelling 30-odd miles to a depot to change programmes, and then going out a further 20 miles in order to give a show the same night. I remember visiting one place, after the armistice, and on our arrival in the early morning we found the hut we were to give the show in was still unfinished, there being about 14 feet at one end to wall up and roof, and a door to be fixed. However, with the help of a few of the "boys" and half a company of prisoners, the hut was finished by tea-time, and all ready for a show at 6.30. We remained here for three days giving a show each day.

I may say that the record time for fixing up my own unit, from time of arrival to time of showing, was two and three-quarter hours; this included unloading, reassembling, and adjusting projector, trimming carbons, fixing cable and wiring up for six lights, and making an improvised operating box, also winding films (7,000 feet); our staff consisted of four men.

We were sometimes called upon, unofficially, to help others in trouble. I recollect at one place a gentleman in civilian clothes was introduced to me, and said he had come "to lecture on Canada." He was one of a group of educational lecturers sent over by the Government to tour France.

He had been informed, he said, that he would find electric light laid on at the camp, and would only have to connect up. The installation, however, was dismantled, and the wiring system so badly cut and disarranged that it presented the appearance of a Chinese puzzle rather than an electricity supply. Would I supply him with electricity and also lend him our screen? I agreed to do this, and proceeded to examine his lantern and effects. I found, however, that the arc in his lantern was of the low-current type, taking about 5 amps. at 200 volts, while my generator produced 100 amps. at only 60 volts, and I had no means of converting it. I did not want to disappoint the troops so, having three hours at my disposal before the lecture, I looked round and discovered a sort of sub-station, about half a mile away, belonging to another camp. I explained my requirements to the man in charge, and he consented to start up half an hour before his time if I could get fixed up. We found a drum of unused cable on an R.E. dump close by, and with this and some of our own wire, laid supply wires from the generator to the hut, half a mile distant. It was tiring work, but still it was something apart from our usual procedure, and we at last got all ready for the lecture.

Then the lecturer confronted me with a box of 120 or so slides, asking me to screen them, as his assistant was not at hand (I don't think he had one). His instructions left him almost breathless. However, all went well, and I was asked to see the lecturer first thing next morning, and was loaded with thanks (and I had had visions of a ten franc note in my sleep that night).

At another camp we visited, we had to drive over some filled-in trenches, and having got in safely and given a three-day show, were about to drive out with our load when, having gone about a dozen yards, the rear wheels of the lorry sank into one of the trenches up to the hubs—it having rained hard all night. After an hour and a quarter's digging, jacking up and bedding of planks, we drove her out of the hole; this was no easy job, as our full load and the lorry together weighed 12½ tons.

On another occasion we were departing after having shown for four days in a fairly well populated village. We found it necessary to turn round in a very narrow street in which some of the walls of the farms had been repaired with a mixture of mud or clay, sand, straw, and a little cement, interlaced with faggots, and were not quite hard.

Our screen box projected from the back of the lorry for about two feet, and in allowing the driver distance in which to back I forgot this, and let him get to within six inches of the wall, with the result that the box went completely through the wall. An irate Frenchman appeared, who shouted he would "*Parlez ze officer.*" However, we took him to a café near by and calmed him down. We parted friends, thankful to have got off so cheaply.

AN ELECTRIC PHONOGRAPH MOTOR.

A New Induction Disk Machine.

Virtually all the small commutator motors that have been placed on the market from time to time for driving phonographs and such like machines are arranged to operate in a vertical position, and to drive the phonograph disk by friction through a pulley mounted on the lower end of the motor shaft and bearing against the outer edge of the disk. A machine produced by the American General Electric Co., and described in a recent issue of the *General Electric Review* is, however, of an entirely different form, and has decided advantages over other types so far as starting torque and speed are concerned, its principle being essentially that of the induction type watthour meter. A promipent phonograph company has decided to incorporate the new type of motor as standard equipment on its machines.

An induction disk motor consists of four essential parts: The stator magnetic circuit, energising coils, phase splitting parts, and the disk rotor of non-magnetic material. The first three elements are necessary in order to create a flux of two component parts out of phase with each other, thus generating "a shifting a.c. field." Part of the flux is used by induction to generate currents and magnetic fields in the disk in such a way that the interaction of the disk and field causes torque. Motors of this type have been used for some time as a component part of measuring instruments wherein accuracy of performance is essential, but they have been

sadly overlooked as small power units whose special characteristics, inherent in their type, make them very useful.

The torque-speed curve, fig. 1, is a straight line starting at maximum torque at standstill and finishing at zero torque at maximum speed. The maximum speed is determined by the ratio of the torque to electro-magnetic damping. The no-load speed is generally seldom over 300 r.p.m., and the speed under load is determined by the amount of torque necessary; the greater the load the lower the speed. The machine is essentially a small power motor on account of its low speed

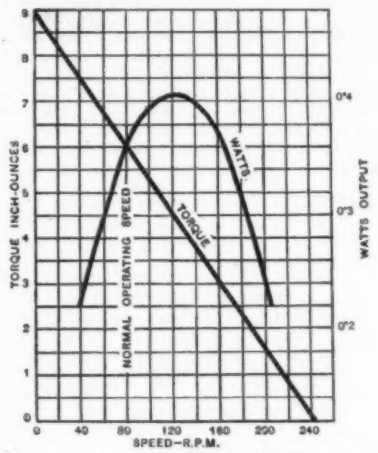


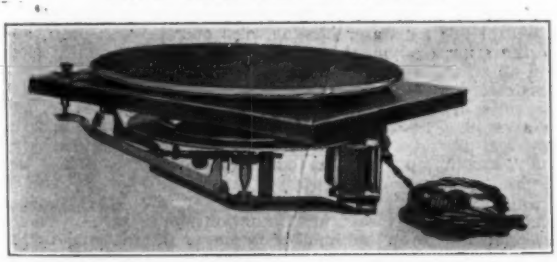
Fig. 1.—Speed-torque and Power Curves of 110-volt Disk Motor.

and poor efficiency, and a power-speed curve, fig. 1, shows that the power is always a maximum at half of the free speed and, of course, zero at standstill and maximum speed.

Since it is an induction motor, the machine is directly affected by a change in frequency; in a motor designed to operate at 60 cycles, the torque reaches its maximum at 40 cycles on account of a much larger input than at 60 cycles. It decreases at lower values because the effectiveness of the frequency is falling off at a greater rate than the increase of input. At the higher values the input is decreasing more rapidly than the increase of effectiveness of the frequency, but a given motor may be operated over a considerable range of frequency provided the minimum torque is sufficient to carry the load.

Figs. 2 and 3 give a general idea of the mechanical design and arrangement of the machine and its parts. The motor

Fig. 2.—Motorboard and Turntable.



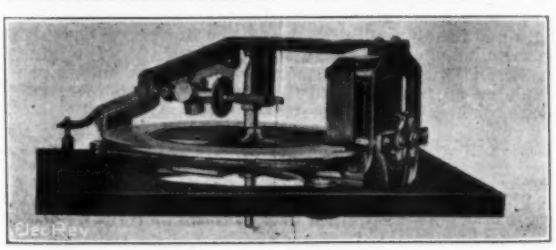


Fig. 3.—Inverted Side View Showing Terminal Arrangement and Governor.

consists of a rotor mounted on the main shaft, the upper end of which supports the turntable carrying the record. The rotor consists of a ring of copper, about 9 in. outside diameter, supported on a cast aluminium spider, and the rotor ring, about 1½ in. wide, revolves through a shifting magnetic field produced by field coils wound on laminated magnetic circuits similar to those in an ordinary watt-hour meter as regards shape, size, and method of producing the shifting field. Thus, with the torque-producing element directly on the main shaft, all necessity for high-speed gearing, belting, or friction drive has been entirely eliminated.

The main shaft is supported in an adjustable hardened steel ball thrust bearing in the lower bracket, while it is held in place by a guide bearing of phosphor bronze in the upper bracket. The lower bracket also supports a governor of the conventional type, which is geared to the main shaft by a silent worm wheel. Reference to fig. 1 will show that the motor exerts maximum torque at standstill, which gradually decreases with increasing speed to the free-speed no-torque condition. This type of curve is particularly suited to phonograph service, since quick acceleration and good speed regulation are possible. Any tendency to slow up while running is counterbalanced by an increase in torque, which results in very close speed regulation under widely varying loads.

Considerable difficulty was experienced in eliminating the magnetic hum, due to the 60-cycle circuit, but it was finally accomplished by a proper design of the supporting brackets and spider, as well as by the elimination of vibration in the motorboard itself. It was found that an aluminium spider was very much quieter than a cast-iron one when supporting the same weight of disk. In the final arrangement the motor was suspended from the motorboard.

The outstanding advantages of this form of electric phonograph motor are: First, due to its extremely simple construction (only two moving elements), its stationary windings, and the elimination of commutator and other sliding contact, there is no successful competitor for reliability. Secondly, the very small amount of power absorbed in bearing friction not only makes this design very effective with regard to weight and power consumption, but gives it a life which is probably limited only by deterioration of the insulation. Thirdly, the motor has been built and attached to the board as a unit, making it completely interchangeable with the spring motor, and weighs only 7.69 lb., as against 10.88 lb. for the spring motor. Fourthly, no damage to the rotor or windings or increase in watt loss results from stalling the motor under full voltage, so that the ordinary type of friction brake may be used.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A 30-volt Bowl Fire.

Having regard to the desirability of low-voltage apparatus for domestic use, and to the fact that there are few appliances suitable for use with small country house lighting sets, we learn with interest that Messrs. Drake & Gorham Wholesale, Ltd., 67, Long Acre, W.C. 2, have placed a 30-volt bowl fire upon the market. This appliance has a 300-watt loading, and is very compact. It is only 9 in. high, and the diameter of the bowl is 5½ in., which makes it convenient for use on a desk or table. The reflector is swivelled, and a wire front makes it possible to use the fire for boiling, &c.

A "Midget" Fuse-switch.

Messrs. Berry's Electric, Ltd., of Switch House, 86, Newman Street, W.1, have recently added to their already large number of designs of foolproof switchgear a "midget" fuse-switch for capacities up to 10 amps., 250 volts. We give illustrations herewith showing exterior and interior views of

Fig. 1.—The "Midget Masta" Fuse-switch.

this fuse-switch (fig. 1). The usual "foolproof" features are embodied in this design, namely, the switch cover is internally locked by movement of the switch to its "on" position, and in addition to this the base contacts of the switch are sunk into the porcelain, which makes it practically impos-

sible for an attendant to come into contact with any live metal. The parts which are required to be handled when inserting new fuse elements are swung well away from the live contacts. This small fuse-switch has been named the "Midget Masta." The fuse carrier consists of an asbestos tube, through which fresh fuse wire may be threaded as occasion arises. The switch case is provided with a single inlet and outlet screwed for conduit, but bushes can be fitted where required. The switch case is of cast iron and of very substantial design, and the manufacturers claim that this switch will undoubtedly replace the 10-amp. coupled tumbler switches with separate porcelain fuses, which are fast becoming obsolete, and quite unsuitable for many of the purposes to which they are put. The price of this ironclad combined fuse-switch compares very favourably with the old-fashioned apparatus which it is designed to supersede.

An Automatic Charger for Electric Vehicles.

The Acme Electric and Manufacturing Co., Cleveland, Ohio, has recently introduced a charger for the batteries of industrial trucks. The charger, known as the "Acme," is intended to charge the battery at the rate recommended by the battery manufacturer. This feature is said to eliminate much of the trouble incidental to the use of too high a charging rate, which will overheat and ruin a battery, or too low a rate, which will "starve" it.

The following points are brought out by the manufacturer: The chargers automatically take care of the charging rate without the use of rheostats; they give a tapering charge, which prolongs the life of lead batteries; they maintain a constant ampere-charging rate; and a safety control on the switchboard ensures protection to the operator. All high-voltage parts are enclosed.

To operate the charger the ampere-hour meter is set to correspond to the truck meter and the charger is started by means of the automatic switch handle. When the battery becomes fully charged the ampere-hour meter actuates a trip in the switch and the motor is shut down, the battery being disconnected simultaneously.

The charger takes up a little more than a square foot of floor space. Its motor is of liberal capacity and built for heavy service; and the generator is constructed to suit the battery. The shaft is one solid piece, rotating on ball bearings, the dynamically balanced armature and rotor both being mounted on it. The commutator has a large radiating surface and maintains a low operating temperature. Cool operation is afforded by a Sirocco-type fan, which ventilates the machine by drawing air through the windings.

An automatically operating panel accompanies the charger. It is made of rubber-finished electrical slate mounted on an angle-iron frame and contains the following equipment: Voltammeter for indicating the battery charging rate and voltage, field rheostat for regulating the generator voltage, fuse for protecting the generator, ampere-hour meter for automatically controlling the charger, this meter also containing a dial which indicates the progress of the charge, and an automatic oil switch for controlling the motor and for disconnecting the battery on completion of charge.—*American Machinist.*

The "Nilfisk" Suction Cleaner (Correction).—In our description of this appliance, in our last issue, we stated that the dust was retained in a cloth receptacle. This, however, is not the case, the cloth acts as a screen to prevent dust from getting into the turbine; the dust is deposited in a metal container facilitating emptying.

THE BUILDING TRADES EXHIBITION.

For the first time since the inauguration of these exhibitions this year sees an annual instead of a biennial one at Olympia, W.; it is the second of a series of three exhibitions to be held in succession, but once again it is disappointing from an electrical point of view.

Mr. J. W. Simpson, the president of the Royal Institute of British Architects, opened the exhibition on the 12th inst., and it will remain open to the public until Tuesday next. The list of popular lectures has this year been considerably extended, and a series of meetings and conferences has been arranged to take place during the run of the show. Out of a total of some 295 stands only about a dozen are of any electrical interest, and not more than four of the latter could be termed "all electrical" stands, which fact is regrettable, since an exhibition of this nature seems to be an exceptional opportunity for enlisting the interest of all connected with housing and the building trade in the subject of "electricity in the home," and the innumerable benefits and economies that are bound to attend the use of electricity, not only for lighting, but also for power, heating, and cooking.

Road engineers visiting the gallery will notice the display made by Messrs. Shell-Mex, Ltd., depicting the application of "Mexphalte" to the processes of road construction. The instruments for determining the ductility and penetration of bitumen are indicative of the scientific work which the company carries out, and specimens of the various grades of bitumen for industrial purposes, such as the manufacture of bituminous compositions, paints, varnishes, waterproof papers and packing materials, roofing felts, damp coursings, hot-neck greases, rubber manufacture, and electrical insulation, form another feature of the exhibit.

Another exhibit of electrical interest on the gallery is that of the Telephone Manufacturing Co. (1920), Ltd., showing a series of automatic intercommunicating telephones ranging from single to 50-line installations of both the desk and wall patterns.

Of the stands on the ground floor that of Carron Company may be mentioned as showing a selection of electrical cooking and heating apparatus in various styles and finishes, and the manner in which electric heaters can be attractively fitted in existing chimney breasts is effectively illustrated.

Amongst the exhibits of Messrs. Parker, Winder and Achurch, Ltd., the "Utility" floor cleaning and polishing machine may be seen, by the aid of which it is claimed that 2,000 sq. ft. of floor space can be scoured and waxed in one hour's time. The device is electrically self-propelled, is fitted with ball bearings, and is claimed to be dust and waterproof. It should prove a useful labour saver in hospitals and similar institutions.

Several electrically-driven vacuum cleaners are shown on the stand of the Staines Kitchen Equipment Co., Ltd., in addition to machines intended for such operations as potato peeling, silver burnishing, &c.

Electric lift makers are represented by Medway's Safety Lift Co., Ltd., showing a complete passenger lift in operation and fitted with dual control, that is, push buttons and a switch worked by an attendant in the cage. Messrs. Waygood-Otis, Ltd., also exhibit a full-size passenger lift, which is used for carrying visitors up to the gallery.

Builders' ironmongery and brass foundry products are on view on the stand of Messrs. Nettlefold & Sons, Ltd., as well as electrical conduit fittings, while Messrs. H. C. Slingsby show a selection of transportation trucks, including an electric battery locomotive such as is used in mines for haulage purposes.

The well-known manufactures of the Sturtevant Engineering Co., Ltd., are represented by turbine vacuum cleaning and ventilating plant, blowing and exhausting fans, &c. A cleaning plant electrically driven by means of an 8-h.p. motor is shown, besides two portable sets, one of the latter being a ¼-h.p. set and the other driven by a 4-h.p. electric motor.

Self-contained electric generating plant suitable for lighting country houses, &c., is exhibited on three stands; a small Webber set is to be seen on the stand of Messrs. S. Smith and Blyth, Ltd., while "Clayford" power and lighting sets together with portable engines ranging in size from 2½ to 15 b.h.p. are shown by Messrs. Cliffords, Ltd., and "Electra" petrol or paraffin engines suitable for a multitude of purposes, by Messrs. F. Sage & Co., Ltd. The last firm also exhibits the "Minor-Domo," 1,000-watt, 32-volt set, and a "Major-Domo" 2,000-watt, 50-volt model. An exceptionally small set seen on this stand will be described in a subsequent issue.

The British Electric Transformer Co., Ltd., the manufacturer of "Tricity" apparatus, shows, in conjunction with a maker of anthracite stoves, an interesting combination of a central fire for water heating, also operating an oven, and in the same equipment electric hot plates, an electric grill, and an arrangement of electric heating elements in the oven. This combination gives great flexibility, the electrical heating elements being able to operate the oven themselves, or act as a supplement to the fire heat, so giving complete cooking power at all states of the fire, in fact, introducing into cooking the "topping-up" idea as between electricity and the use of crude fuel.

Amongst the numerous machines for the production of concrete building blocks and imitation stone there is an interesting device for tamping or ramming the material in the moulds. This consists of an electrically operated machine on a wall bracket with jointed arms and belting driving a light and handy vertical rammer. The first suggestion arising in the mind of an engineer witnessing the use of this apparatus is, that it would be extremely useful in large foundries for ramming up the sand, and it may be worth the attention of electrical engineers in the metal working areas.

Electric Motors in Holland.—The report of the Electromotoren Fabriek Dordt, dealing with a period of 18 months from July 1st, 1919, to December 31st, 1920, states that the imports of foreign motors were delayed longer than had been expected, foreign rivalry having been of little account in the first 14 months. It was very difficult to procure raw materials; a period of from 8 to 12 months was required to secure the delivery of dynamo sheets and insulated copper wire, and it was, therefore, essential to order larger quantities of these materials than were necessary for immediate needs. A sudden fall in prices however, set in. Besides, raw materials being offered at considerably reduced prices, and for more prompt delivery, the country was inundated with foreign motors in a few weeks. In order to meet this state of affairs, it was necessary to write down the stocks of manufactures and of semi-finished products, and make reserve provision for goods on order last December, but not yet received by the company, so that the net profits only amounted to 34,000 florins. It is not intended to pay any dividend, but to transfer the profits to the reserve fund, and carry a small balance forward.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession*

The Gatehouse Lamp Patent.

In your reference to the late Mr. Gatehouse, you mention a patent in connection with incandescent lamps. Some 38 years ago, when as a boy I was working for the Pilsen, Joel and General Electric Light Co., Malden Factories, Kentish Town, part of my duties was in connection with what I understood was the patent mentioned.

The lamp filament was mounted on platinum spirals, about 3/32 in. in diameter and about 1 in. long; the gauge of wire depended upon the voltage and candle power of the lamp, but was thin. I wound many thousands of these spirals.

The wire acted as a resistance to the somewhat varying pressure of supply of that period.

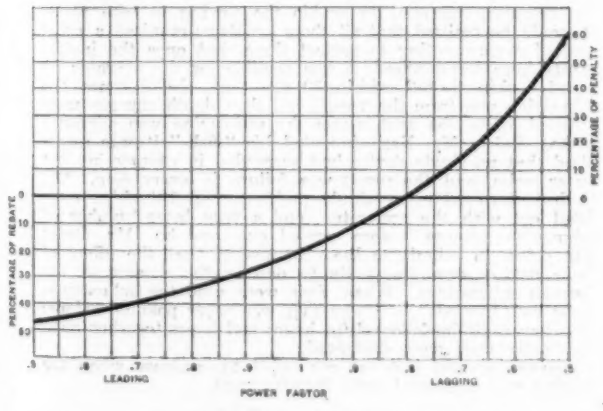
S. F. Emerson.

West Kirby.
April 13th, 1921.

Charging for Idle Current.

The ingenious method devised by Mr. Carrothers (your issue No. 2,262, p. 404) in substitution for Prof. Arno's method of charging for idle current has certain advantages. Although Arno has shown that it is quite easy so to modify a cosine meter that it will register with fair accuracy the equivalent of the kWh corresponding to any combination of kWh and kVAh, the use of a specially constructed meter alone will be always looked at with suspicion by the customer, and he will require an ordinary cosine meter in addition. The two meters will (except for p.f. unity) not agree, and the customer has no means of checking the correctness of Arno's meter to see whether it really registers what Arno calls the complex charge (his term is "carico complesso"). A third ordinary sine meter will, therefore, have to be added. Under the Carrothers method only two meters are required, a sine and a cosine meter, both of which are of the ordinary construction, and therefore easily obtainable from any meter maker. From these two meters the average p.f. over a given period for which the account has to be made up can easily be calculated, and even if the customer himself is not sufficiently versed in trigonometry to calculate the cosine from the ratio of the two readings, his engineer can do this.

Under Arno's method the customer is penalised equally whether he takes a lagging or leading idle current; under Carrothers's method there is some discrimination, but not enough. In both systems the chief idea is to penalise for bad p.f., and not to give a bonus for good p.f. Dynamo makers have succeeded in producing self-starting synchronous motors which are advertised to take leading components down to 0.6 p.f., but what is the good to the consumer of such a motor if under the Arno system he is penalised to the same extent whether his p.f. is due to a lagging or leading component of the current he takes, and under the Carrothers



method the discrimination can only be small? The power companies are quite alive to the fact that an increase in the p.f. over the whole system is of great commercial value; they also recognise that the large number of motors of bad p.f. already connected to their systems cannot be scrapped, and therefore allow their customers a certain minimum p.f. without penalty. The principle of granting a rebate on good p.f. becomes, therefore, necessary. To my knowledge, this principle has been adopted by a large power company with good results, but there are probably others.

Let, for instance, the permissible p.f. for lagging current be 0.8. Sine and cosine meters are installed, and the average p.f. over a certain period (a month or a quarter) is calculated from the meter readings. If it comes out at 0.8 the account is presented in the usual way as it stands, including coal clause and rebate for quantity. If the average p.f. comes out at some other figure, say 0.7 lagging, the account made up for kWh in the usual way is multiplied with a coefficient which is the ratio of 0.8 to 0.7, or $0.8/0.7 = 1.14$. The customer would, therefore, have to pay 14 per cent. more per unit than if he had kept his p.f. to the contract value of 0.8. If, on the other hand, the average p.f. comes out from the meter readings at 0.9, the coefficient is 0.89, and he would get 11 per cent. rebate on the cost per unit at the agreed p.f. of 0.8.

The question now arises how the account shall be reduced if his average p.f. comes out at less than unity, but leading. This will be shown by the sine meter running backwards. In such a case the denominator might be calculated as $2 - \cos \varphi$. Under this system the penalty or rebate in percentage of the charge for kWh supplied is given in the accompanying chart. The method suggested by Mr. Carrothers is retained, and only its application is altered to encourage customers to improve their p.f. as well as to discourage them from taking current at a bad and lagging p.f.

Gisbert Kapp.

Birmingham.
April 14th, 1921.

Electricity Supply without Statutory Powers.

I am at present in charge of an estate electricity works and wish to extend my mains, and we are an unauthorised undertaking. Am I bound by the Electric Light Act of 1888? Also what obligations am I under as regards the protection of telephone wires against my power wires falling? I may say that all the roads on the estate are private roads, upkept by the estate.

Inquirer.

April 18th, 1921.

[Many inquiries of this kind come to hand, and are answered by letter; it appears, therefore, that a general statement may be of interest to a good many of our readers.

Before the Act of 1909 was passed, the unauthorised supplier had a free hand; he could commence business anywhere, and supply electricity by overhead lines (but not by underground mains) at pleasure, to anyone. He was—and is—not hampered by the necessity of compliance with the regulations imposed upon authorised undertakers, with the exception that he must erect his lines in accordance with the requirements of the Board of Trade and the Postmaster-General. No local authority could veto his plans or interfere with his business in any way, with one exception—if the local authority owned the "fee simple" of the roadway (a rare case) it could withhold permission to carry lines across it. He could charge whatever price his customers were willing to pay, and he could go out of business if he chose, while he was under no obligation to supply any person.

The passing of the Act of 1909 did not alter the position of those unauthorised suppliers who were then supplying electricity, but it provided that in future no such business should be commenced within an area over which any authorised undertaker had powers to supply, unless the supply of electricity were a "side-line," subsidiary to the main business of the unauthorised person or company.

The Act of 1919 went further, by rendering the establishment of a new station or the extension of an existing one subject to the consent of the Electricity Commissioners (who have to hold a local inquiry before they can withhold such permission or impose conditions). No penalty is specified in the event of a station being built or extended without permission, but intending suppliers would be well advised in obtaining the consent of the Commissioners.

In the case of our correspondent, he is at liberty to extend his mains at pleasure, and need only comply with the regulations for overhead lines issued by the Ministry of Transport (successors to the Board of Trade) and the requirements of the Postmaster-General with regard to telephone wires. As the roads are private, he can use underground cables if he wishes.—EDS. ELEC. REV.]

The Training of Kinema Operators.

With regard to Mr. F. C. Drier's letter *re* kinema operators, being an electrician operator of several years' experience, I should be much obliged if you would allow me to voice my opinion. First of all, Mr. Dreier says he thinks most of the fault is with the institution teaching operating; but if anyone desires to be an electrician he does not go to a catch-penny school—if young enough, he becomes an apprentice, and enlarges his knowledge by study and attending technical evening classes. If he is too old to become an apprentice, it is hard for a man to get on; this ought not to be so. Exceedingly few electrician operators learned at a school; they attended the real thing, and educated themselves by book knowledge, not being able to attend technical classes. No school tuition is of much service; operating is like other trades, you have to serve your time to it. Age ought not to be a barrier. Some kinema managers run operating down, and say they can put anybody on the job, hence the number of lads getting sweated wages. If a manager has to pay a decent wage suitable for a fully-qualified man, and he has a dud operator,

the remedy is in his own hands, there are hundreds of operators out of work, some good men, too. A kinema trade paper runs a set of test questions, and allots certificates to successful candidates; this has been going on over a year, and yet only 21 out of all England have so far been successful in obtaining certificates. Certification of operators would improve the general status; but will it ever be?

Electrician Operator.

Bolton.
April 3rd, 1921.

Fuses for Sub-stations.

With reference to the article in the ELECTRICAL REVIEW dated April 15th on the above subject by a "Central-Station Engineer," it may be of interest to your readers to know that the firm whom I represent in this country (The Electrical Apparatus Manufacturers, Sprecher & Schuh Co., of Aarau, Switzerland) are makers of the particular types of fuses for medium pressures recommended by your contributor.

After many years' experience they have evolved two types of fuses for these pressures, one being for heavy currents up to 3,000 amperes of the open replaceable type with horn break, and the other being of the handle type with clip contacts for currents up to 600 amperes, the fuse strips being of zinc, which combines the advantages of a low melting temperature and a minimum explosive effect. The fuse carriers in this type are made of a specially tough fireproof insulating material.

J. B. Rudkin.

London.
April 16th, 1921.

The Grading of Mains Engineers.

I think that every charge engineer in the country, and especially those in large stations, fails to see the reason why mains engineers should be graded on a higher level for pay than themselves. It would be absurd for anyone to argue that their qualifications for the superintendence of wire-laying work entitle them to higher pay than that paid to charge engineers, whose responsibilities in large stations are enormous, and who have to take their regular turn on night and Sunday duty. If I may have an opinion, I think this is a matter that should be considered by the National Joint Board of the Employers and Electrical Power Engineers' Association. There is a wide belief, too, that there is far too much favouritism shown by chief engineers to "kow-towing" men when there is a promotion to be given, or vacancies are to be filled. In a station near London where I was employed for a short time some years ago, I found that the station superintendent was a man without any electrical engineering qualifications whatever, but he was possessed of special ability as a "kow-tower" to the chief, and as a coarse bully to his subordinates. The result was that no self-respecting young engineer remained at the station for more than a few months.

N. B.

April 18th, 1921.

The Heating of Buried Cables.

In my letter to you of the 6th inst., an unfortunate slip occurred in the fourth line of the fourth paragraph. The word "considerably" should not have been inserted. The sentence should read: "The losses in unarmoured cables are in each case greater than those in armoured cables . . ."

A. M. Taylor,
Hon. Major, S.O.2, W.B.A.M.

Birmingham.
April 16th, 1921.

LEGAL.

THE NASH FISH HYDROPHONE.

ON Monday last, before the Royal Commission on Awards to Inventors, the case was commenced of Mr. George Howard Nash, C.B.E. (chief engineer and a director of the Western Electric Co.), Mr. A. A. Mack, Mr. Bertram B. Grace, and Mr. G. E. R. Penny, who put forward a claim in respect of the Nash fish hydrophone and the Western Electric hydrophone equipment—apparatus used for the purpose of detecting the presence of submarines in the late war.

The Court was presided over by the Hon. Mr. Justice Sargant, with whom were Sir Charles Ellis, Sir James Dobbie, Mr. Temple Franks, Mr. Young, and Mr. Norton.

The applicants were represented by Mr. Hunter Gray, K.C., Mr. Barrington Ward, K.C., and Mr. Caradoc Rees (instructed by Messrs. Hyman Isaacs, Lewis & Mills) solicitors. The Crown was represented by Sir Arthur Colefax, K.C., and Mr. Moritz.

Mr. HUNTER GRAY, K.C., in opening the case, explained that the Western Electric Co. were not the claimants, although the company were entitled to the greatest credit for the work which they performed in connection with the matter. It was a claim by four gentlemen who were employés of the Western Electric Co., and it was in respect of what was known as the Nash Fish, which was not an instrument, but a system embodying several instruments, used very largely for the detection of submarines, and which enabled them in many cases to be destroyed by depth bombs. It was in April, 1915, that the German submarine menace became a real danger, and the danger increased until in the autumn of 1916 it caused a great deal of anxiety in this country. The menace went on increasing until the middle of 1917 when something like one million tons of shipping was being destroyed per day. The Commission would understand that during the whole of that period it was vital that some means should be found to prevent, if possible, that tremendous destruction of shipping. Many elaborate investigations were carried out for the purpose of finding some solution. Among them were mines which were laid in the traffic areas of the submarines, nets, the "Q" boats, &c. Some of the best scientific brains had directed themselves to the problem. He would not tell the Commission in detail all that Mr. Nash did—it was sufficient for the moment to say that from the beginning of the war the Western Electric Co., and the four claimants, were working on devices of various kinds for war purposes, and in November, 1916, Mr. Nash in particular turned his attention to the problem of dealing with the German submarines. From that time until April, 1917, the work which Mr. Nash and his colleagues did in that connection was almost superhuman. The problems to be faced were multitudinous, but in the end they succeeded in perfecting a system which was eminently useful for the purpose for which it was designed. By October or November, 1917, there were something like 180 trawlers, all of which were built for the purpose, and fitted with the system. Although Mr. Nash was a scientific man of very great skill and knowledge, he began with the very elements of the subject. He consulted every book which he could find which gave him any information on the conductivity of sound in water, and having equipped himself with that knowledge, he proceeded to work out the various elements in the problem, and he began with the microphone. The first problem Mr. Nash had to solve was to get a microphone which would be affected on both sides. Some of the other scientific men who were working on the problem had solved that, but not to the knowledge of Mr. Nash. In addition to both sides of the diaphragm being equally affected, it was necessary to know not only that it was in the line of the diaphragm, but they must know from what direction the sound came, whether from the right or the left. The next problem which Mr. Nash had to tackle was to invent a unidirectional hydrophone, and that was eventually accomplished. Counsel explained how by an arrangement of the two microphones it was possible not only to get the direction of the line to the submarine, but the "sense" of it. He was, he said, instructed that that device was absolutely new at the time Mr. Nash invented it. Another problem which Mr. Nash had successfully solved was moving the hydrophone transmitters through the seas at high speed without affecting their efficiency. Such a device might have been suspended from the ship itself, but the difficulty there was that they would have had trouble with the noise of the engines, and by the surging of the water, and therefore Mr. Nash took the quite original step of suspending his fish at the extremity of a long, steel composite rope about 200 ft. long. That was towed behind the ship, and the rope contained all the conductors that were required in addition to the necessary material to enable the towing to take place. It would be realised that all those problems required a great deal of experimenting to perfect them, but once the instruments were standardised, it was possible for the operator on board a ship to tell within 10 per cent. the distance the submarine was from the vessel, and then depth charges were dropped above the spot where the submarine was supposed to be. Before Mr. Nash invented his "fish" it was recognised that no single device had succeeded in overcoming the water noise, and the result was failure in every case. Mr. Nash had solved every single problem, and 184 ships were fitted out with the apparatus, and a very large number of submarine "hunts" were carried out, and he (Mr. Gray) was going to submit to the Commission that the effect of those devices was practically to destroy the danger of the German submarines. When they were used the submarines could be "hunted" in a way that was never possible before; and they could be followed for hours and hours together until eventually they were destroyed.

Learned counsel had not concluded his address when the hearing was adjourned until Monday next.

SEMCO, LTD., *v.* SPOONER.

IN the Shoreditch County Court, on April 14th, before Judge Cluer, Messrs. Semco, Ltd., of High Street, Shoreditch, electrical manufacturers, sued Mr. R. J. Spooner, of Forest Gate, butcher, to recover £7 8s. 6d. for repairs to an electric motor.

It appeared that the defendant had a small electric motor running in his shop which he wished to have repaired. The work had been done satisfactorily, but it was stated that the price was excessive.

Mr. HOLT, of 127, St. Stephen's Road, East Ham, an electrician, was called for the defence, and said that if he had been offered the work to do he could have carried it out properly and made a profit by charging £3 15s.

Judge CLUER found for the plaintiffs for £5 and costs.

Postmaster-General v. Liverpool Corporation.

An action seeking to recover the cost of repairing the damage to telephone cables, the result of an explosion which occurred in August, 1918, was heard at the Liverpool County Court, when the Postmaster-General sued the Liverpool Corporation in respect of the sum of £40.

On behalf of the Postmaster-General, it was stated that when the Government took over the telephone system from the National Telephone Co., certain agreements between the company and the Corporation lapsed. The Postmaster-General claimed that he was entitled to obtain the cost of the repairs to the telephone cable which it was alleged had been damaged by a faulty electric light cable of the Liverpool Corporation.

The Corporation contended that the fact that the Postmaster-General had taken over the telephones did not entitle him to treat agreements entered into between the Corporation and the National Telephone Co. as having lapsed. It was argued that the Corporation should not be liable through the telephone and electric light cables being in contact.

His Honour Judge Thomas, gave judgment for the Corporation with costs. He said the Postmaster-General was still bound by the agreements referred to. He found that the telephone cable had been negligently and improperly laid by the Telephone Co. in contact, or practical contact, with the Corporation's electric cable.

Colliery Fireman Fined.

Before Sheriff Macdiarmid, at Airdrie, Robert Hendry, colliery fireman, Lang Street, Coatbridge, admitted a charge of having failed to keep the removable handle of the electrical firing apparatus in his personal custody, he being authorised to fire shots electrically, and allowing it to be in the custody of two others. The Sheriff imposed a fine of £5, with the alternative of 30 days' imprisonment.

Bastian Electric Co., Ltd.

The petition of W. F. N. May and others for an order for the compulsory winding-up of this company was before Mr. Justice P. O. Lawrence in the Companies Winding-up Court on April 12th. The petitioners were judgment creditors, and the petition was adjourned for 14 days.

Portable Electric Motors (1919), Ltd.

Upon the petition of Electric Tools & Motors, Ltd., Mr. Justice P. O. Lawrence, in the Companies Winding-up Court, on April 12th, made an order for the compulsory winding-up of this company. The petitioners, it was stated, were judgment creditors for £160. There was no opposition.

Workmen's Compensation.

At the Southport County Court, on April 12th, an application was made for an order regarding certain compensation moneys respecting the death of an electrician in the employ of the Vulcan Motor & Engineering Co., named John Gilbert Anger, who was killed as the result of an accident arising out of his employment in November last. Mr. A. J. Mawdsley, solicitor, said that since the commencement of an application for arbitration the Vulcan Co. had paid into court £300 which, he understood, was the maximum sum payable on death in such circumstances. The judge consented to the paying out of £75 to the widow for the discharge of her debts, which included £40 for furniture, the balance to be invested with liberty to apply for its apportionment as between the widow and the children.

Hackney Borough Council to be Summoned.

It is reported in the daily Press that on Saturday last Mr. S. Y. Tilley, solicitor, applied to Mr. Disney at North London Police Court on Saturday for a summons against the Hackney Borough Council for failing to supply electric power to certain premises, contrary to the provisions of the Hackney Electric Lighting Order, 1893.

Mr. Tilley explained that his client had made formal application for a supply of electricity, which the Council was bound to give, and had employed a master man to do the wiring inside the premises. While this work was in progress the electrician received a visit from a person representing himself as a shop steward from the Council's electricity department, who requested to see his "ticket." "What ticket?" asked the electrician. "Your union ticket," was the reply. The electrician answered: "I am a master man and do the work myself. I employ no labour." The shop steward informed him that as he did not belong to the union the Council's men would refuse to connect the premises, and this decision was afterwards confirmed by the borough electrical engineer. Under Section 26 of the Order the Council became liable to a penalty of 40s. a day for refusing to connect the premises.

Mr. Disney granted the summons.

MERSEY AND WEST LANCASHIRE ELECTRICITY DISTRICT.

We have received the following communication from the Electricity Commission:—

The Electricity Commissioners having considered the evidence submitted at the recent inquiry at Liverpool into the two schemes submitted respectively by the Conference of Mersey and West Lancashire Electricity Authorities, and by the Corporations of Wallasey and Birkenhead, have arrived at the following conclusions:—

1. The area provisionally determined is confirmed subject to the inclusion of the urban districts of Lymm, Haydock, Northwich, Middlewich, and Winsford, and the rural district of Northwich.

2. A Joint Electricity Authority will be formed for the whole district, subject as hereinafter appears.

3. The advantages to the Local Authorities of the Wirral Peninsula of independent combination will for some years outweigh those of inclusion in the scheme for the whole area. Subject to liaison with the Joint Electricity Authority, a separate Committee will be established representative of the Local Authorities for the following districts, namely, the county boroughs of Birkenhead and Wallasey, the urban districts of Hoylake and West Kirby, Bromborough, Higher Bebington, Lower Bebington, and Neston and Parkgate, and the rural district of Wirral (hereinafter referred to as "the Wirral Area").

Although the Commissioners have arrived at this conclusion after a critical comparison of the estimates laid before them by the promoters of the two schemes as subsequently amended by the Commissioners, they are of opinion that it may be found advantageous to merge the Wirral Committee in the Joint Electricity Authority at some future date.

4. A capital station in the neighbourhood of Liverpool, and a transmission system connecting it with Liverpool, Bootle, Prescot, and St. Helens, are immediately required, and will be of advantage to the neighbouring districts.

5. The fullest and most efficient use should be made of the generating plant of the Mersey Power Company, Limited. The company, by arrangement with the Joint Electricity Authority, and with the approval of the Commissioners, and subject to suitable conditions, may be empowered to extend its operations by bulk supply or otherwise into neighbouring districts. The Company will have separate representation upon the Joint Electricity Authority, to which it will elect one member.

6. The areas of the Wirral Committee and the Mersey Power Company, Limited, should in due course be linked up with the remainder of the area.

The Electricity Commissioners have accordingly decided to prepare a draft Order providing (*inter alia*):—

(*a*) For the establishment of a Joint Electricity Authority for the whole district, including the additional areas enumerated in paragraph (1), and the Wirral area.

(*b*) For the establishment of an independent Committee for the Wirral area.

(*c*) For any consequential modifications in the constitution of the Joint Electricity Authority proposed in the scheme of the Conference of Mersey and West Lancashire Electricity Authorities. The Wirral Committee will elect one member of the Joint Electricity Authority.

(*d*) For the inclusion of outlines of the technical schemes to be undertaken by the Joint Electricity Authority and the Wirral Committee respectively, but will provide that modifications thereof may be made with the approval of the Commissioners.

(*e*) For the Joint Electricity Authority and the Wirral Committee respectively being required to submit, within a period of two years from the date of their formation, proposals for giving or securing a supply in unoccupied areas where there is a reasonable prospect of such supply being remunerative.

(*f*) For the *administrative* expenses of the Joint Electricity Authority being met by contributions from each of the interests represented on the Authority, and for any deficiency on revenue account which may arise from the supply of electricity being, by a re-adjustment of charges or otherwise, met only by those undertakings which are connected with the Joint Electricity Authority's transmission system.

(*g*) For the necessary financial powers being conferred on the Joint Electricity Authority and the Wirral Committee, subject in the former case to the enactment of the Electricity (Supply) Bill now before Parliament.

Pending the establishment of the Joint Electricity Authority and the Wirral Committee, the Commissioners will ask the parties concerned to form two small provisional committees with which the Commissioners may consult from time to time with regard to any development of supply in the Electricity District and the Wirral Area respectively.

The observations of the parties represented at the recent inquiry will be invited on the clauses of the draft Order before the Commissioners hold the further inquiry required by Section 5 (4) of the Electricity (Supply) Act, 1919.

A communication in the above terms is being made to all parties represented at the inquiry.

BUSINESS NOTES.

Bankruptcy Proceedings.—J. Skinner (Foster, Skinner and Co.), electric fittings dealer, Liverpool.—First and final dividend of 1s. 3½d. in the £, payable April 22nd, at the Official Receiver's Offices, 11, Dale Street, Liverpool.

John Vincent Bell, 21, North Bar Within, Beverley, East Riding, Yorkshire, electrical engineer.—The adjourned public examination of this debtor was held recently at the Guildhall, Alfred Golder Street, Hull. It appeared that debtor commenced business in February, 1920, after being apprenticed to the trade. The statement of affairs showed liabilities of £449, against assets estimated to realise £455, or a surplus of £6. He attributed his position to a general falling-off in trade since September, and damage done to his business by reason of his arrest. It was further stated that the charge on which he had been arrested had been withdrawn. The examination was closed.

L. P. Howse & G. H. B. Snell (Howse & Snell), electrical engineers, Margate.—Trustee, Mr. J. C. Goldsack, 5, Cecil Square, Margate, appointed April 11th.

Company Liquidations.—British Rubber Manufactures, Ltd.—A first and final dividend is to be declared. Proof of debts has to be made by May 2nd. The liabilities are £80,000. The assets estimated available for dividends are £4,800. Mr. H. Brougham, 33, Carey Street, W.C., is liquidator.

Orizaba Tramways Syndicate, Ltd.—Meeting of creditors called for Monday last at Sardinia House, W.C.

Anglo-Foreign Tramways Syndicate, Ltd.—Meeting of creditors called for Monday last at Sardinia House, W.C.

Wigan Electro Metallurgical Works, Ltd.—Winding up voluntarily. Liquidator, Mr. J. Airey, 8, Victoria Street, Liverpool, to whom particulars of claims should be sent forthwith. Meeting of creditors called for April 27th.

Dissolutions of Partnership.—Saunders, Garner and Mothersdill, electrical, motor, and mechanical engineers, 249, Regent Road, Salford.—Mr. F. Garner and Mr. F. Mothersgill have dissolved partnership. Debts will be attended to by Mr. F. Garner, who will continue the business under the style of Garner & Co.

British Telephone Supply Co., 14, Snow Hill, Birmingham.—Messrs. G. H. Hanson, W. C. Carter, and A. H. Hanson, have dissolved partnership. Debts will be attended to by Messrs. Carter and A. H. Hanson, who will continue the business under the same name.

Trade Announcements.—Messrs. George Nobbs, Ltd.,' of 89, Cleveland Street, Fitzroy Square, London, W. 1, have taken over the sole selling rights for the world of "Provoi" electrical insulating composition, which takes the place of what has long been known as Chatterton's compound. For the last five years their entire output has been absorbed by about 12 British manufacturers of generators and motors, and certain telegraph, telephone, and traction companies.

Messrs. Berry & Moodycliffe, late of the South of Scotland Electrical and Mechanical Engineering Co., Ltd., have commenced business as electrical engineers, at Milldamhead, Annan Road, Dumfries.

The Commercial Cable Co. has opened a new cable office at 75, Edmund Street, Birmingham, for the convenience of this large industrial centre.

Premises at 7, Victoria Square, Truro, have been opened as showrooms by the Electric Light, Motor and Engineering Co., of which Mr. H. Colling Hall is the manager.

Mr. Neil Cameron and Mr. Campbell Gardner, of 44, Upper Arthur Street, Belfast, and 68, Dame Street, Dublin, have entered into partnership and commenced business at the above addresses as electrical and mechanical engineers' agents and wholesale factors. Catalogues and price-lists requested.

Catalogues and Lists.—The London Electric Firm, Brighton Road, Croydon.—Leaflet No. 274, giving sizes and prices of flexible steel wire ropes; Leaflet No. 275, a price list illustrating and describing winches, ropes and pulleys; also two circular letters, one regarding stocks of searchlight mirrors of various types and sizes (priced), and the other (with blue prints) advertising a stock of disused steel and wood poles suitable for lighting, telephone lines, &c.

Messrs. L. G. Hawkins & Co., 116, Charing Cross Road, W.C. 2.—"The Electrical Link," Vol. I, No. 3, advertising "Universal" electric washers and other products; also two illustrated pamphlets dealing with "Universal" toasters, percolators, vacuum cleaners, immersion heaters, &c.

Messrs. S. G. Leach & Co., Ltd., 26-30, Artillery Lane, E. 1.—List FCM 11, a priced pamphlet giving particulars and illustrations of desk, bracket, and oscillating electric fans; also an illustrated price sheet of fractional h.p. motors, ranging from $\frac{1}{70}$ to ¼ h.p.

Messrs. Ferranti, Ltd., 180, Fleet Street, London, E.C. 4.—Illustrated and priced leaflet, List Ga 354, giving full particulars of the Ferranti-Hawkins system of cable protection.

Messrs. Mossay & Co., Ltd., 7, Princes Street, Westminster, S.W. 1.—A catalogue giving numerous illustrations of "Orwell" industrial electric vehicles applied to various businesses. Particulars of running costs are given.

The Edison Swan Electric Co., Ltd., Ponders End, Middlesex. Leaflet No. A.A. 214, dealing with "Ediswan" circuit-breakers, and Leaflet B.B. 215, advertising "Ediswan Acme" accumulators.

The Benjamin Electric, Ltd., Brantwood Works, Tariff Road, Tottenham, N. 17. Catalogue L-6.—This is an extremely well-produced publication divided into seven sections as follows:—(1) Industrial lighting fittings; (2) outside lanterns and well-glass fittings; (3) electric lighting devices; (4) shop-window lighting material; (5) industrial signals; (6) automobile accessories; and (7) accessories and spare parts. Each section is profusely illustrated, some excellent photographs of lighting systems being included, and a great many data are also supplied. Prices are given where possible.

The British Thomson-Houston Co., Ltd., Rugby.—Descriptive List No. 2,531—A. This is a copiously-illustrated brochure dealing with "Fabroil" pinions and their applications. A great amount of technical data in this connection is included in the publication.

Athol Engineering Co., 9, Peru Street, Higher Broughton, Manchester.—A price-list (C 3. 150,421) of sheet celluloid, with conditions of sale, &c.

Messrs. Hyatt, Ltd., Thurloe Place, South Kensington, S.W. 7. A list giving drawings and dimensions of roller bearings for loose pulleys and countershaft boxes.

Electricity Supply Rifle League.—The following are the results of the matches shot during March:—Shoreditch 583, Central, 557; City Co. 561, Fulham 481; City Co. 571, Central 552; Shoreditch 583, St. James's 554; St. James's 555, Brompton 534.

Book Notices.—"Riffelbekämpfung und Riffelmessung." By F. Schrey. Pp. 19, figs. 5. Vienna: From the author. Price M.20.—This is a pamphlet on the removal of corrugations on railway track by means of a track-grinding rail motor-car, and the measurement of corrugations on tramway lines, issued by the chief inspector of the municipal tramways in Vienna. It deals with the cost of removal of corrugations on rails by various processes, and contains a description with illustrations of a new device for measuring corrugations; it is the result of investigations made under the superintendence of the author by the municipal tramway department of Vienna.

"The Metropolitan-Vickers Gazette," Vol. VI, No. 96, March, 1921.—In this issue, Mr. Juhlin's paper on "The Temperature Limits of Large Alternators," read before the I.E.E., is reproduced. Other articles are:—"Electrical Drive in Cotton-Spinning Mills," by V. Mallalieu; "Radiology Applied to the Testing of Materials," by A. P. M. Fleming, C.B.E., and J. B. Clarke, M.Sc.; and "The Electric Road Vehicle," by W. D. Sheers.

"Science Abstracts." Vol. 24, Part 3. Section A—Physics (88 pp.); Section B—Electrical Engineering (54 pp.). London: E. & F. N. Spon, Ltd. Price, single numbers, 2s. 6d.

"Engineering Abstracts from Current Periodical Literature," new series, No. 7, April, 1921 (275 pp.). London: The Institution of Civil Engineers.

"Contact," the *Journal* of the National Association of Supervising Electricians. Vol. II, No. 4, April, 1921. London: The Association.—This number contains illustrated articles on "Battery Control by Ampere-hour Meter," and "Progress in Lighting," a report of proceedings at the annual dinner, &c.

Electrical Manufacturing in Australia.—Protests were recently lodged with the Sydney City Council against the decision of the Electric Lighting Committee to recommend the purchase of a transformer of local manufacture at a price some 20 per cent. in advance of the tenders from oversea manufacturers. The Australian Overseas Committee of the British Electrical and Allied Manufacturers' Association emphatically protested against such preference. The British manufacturers, the letter stated, had to allow in their tenders for freight, insurance, exchange, &c., as well as duty, in the case of the transformer 30 per cent. *ad valorem*, so that in this way alone local manufacturers were protected to the extent of approximately 45 per cent. The general impression was that the new rates of duty were fixed in such a way as to give the necessary preference to local manufacturers over the British, and that it was no longer necessary to give a further preference to local manufacturers. It was, therefore, surprising that in this instance a preference of 20 per cent. was recommended. If this policy was adhered to, it would seem useless for British firms to continue tendering, and in the circumstances it would leave the field entirely open to local manufacture, eliminating healthy competition. It would be recognised that the total load of 65 per cent. could not possibly be faced by British manufacturers. The letter further pointed out that no preference should be given to local over British manufactured articles, on account of duty, &c., which was already intended to serve that purpose. It would be glad if the Council would define its policy on the question in connection with future contracts. A second letter in similar strain was received from Messrs. Noyes Bros. (Sydney), Ltd. The Council, however, agreed to the recommendation of the Electric Lighting Committee, that the tender of the English Electric Co. of Australia, for the transformers, involving a sum of £13,700, be accepted.—*Industrial Australian and Mining Standard.*

New Italian Companies.—There has been formed at Antrona Piana, province of Novara, the Società Forze Idrauliche Valle Antrona, with a capital of 1,000,000 lire, for the generation of electricity from the River Antrona.

At Oliveto Citra has been embodied the Società Idro-elettrica Valsele, for the utilisation of energy generated from the River Inceglia. Its capital is 1,000,000 lire.

The Photographic Fair.—A Photographic Fair is in progress at the Horticultural Hall, Westminster, where all phases of the art are to be seen. Naturally cameras, plates and lenses form the greater part of the exhibition, but several electrical appliances are on view. There are numerous small articles shown, such as the Richardson dry-mounting fixing iron, which is similar in appearance to an electric soldering iron. This has a small loading, and is suitable for attaching to an ordinary lampholder. Then there is an electric printing box; this is for use where a supply of electricity is not available. It consists of a box in which is placed a small electric lamp supplied by a pocket battery. Prints upon "gaslight" paper can be obtained in a very short time by this means. Messrs. John J. Griffin & Sons, Ltd., of Kemble Street, Kingsway, show a "Barkay" reflector which, it is claimed, increases the actinic value of the rays from a gasfilled lamp by 800 per cent. The reflector is of glass, silvered on the back. The surface of the reflector is a series of tiny depressions and convexities, so that within the main light beam (which is not visible, and does not photograph) are myriads of secondary light pencils striking at every angle. The effect gained is as though the light originates from an incandescent mass of some 150 sq. in.—the whole area of the Barkay—instead of from a small filament or arc alone. As a result, the outline of cast shadows is softened and "fluffy." Diffusing screens, which frequently absorb 70 per cent. of the light, may be dispensed with, or reduced to a very small size just sufficient to mask the direct rays from the light source.

Messrs. Newman & Guardia, Ltd., 17-18, Rathbone Place, Oxford Street, W. 1, exhibit "Triumph" outfits for photographic work. The 5-A set shown comprises a 1,000-c.p. lamp and Mangin reflector, with a sliding resistance to vary the intensity of the light. This can be operated from house wiring, or an accumulator battery can be employed.

Messrs. Ross, Ltd., Clapham Common, S.W. 14, have on view an example of their kinema projector. The special lenses used in this machine result, it is stated, in a considerable saving of current while giving brighter illumination than the machines of most other makers. The arc is of the six-movement type, making adjustment a simple matter. A specially-designed shutter is supplied with the machine. It is the outcome of many experiments in connection with light transmitting power and the elimination of flicker. In this shutter the alternate "cover" and "open" segments are covered with translucent gelatine; the "cover" segments are violet-coloured. This arrangement ensures that the light is never cut off from the screen, and the usual flicker, therefore, is absent. The ¼th-h.p. motor which is embodied in the machine is swung and counterbalanced, so that the tension in the pulley-driving belt is maintained constant.

Messrs. W. Butcher & Sons, Ltd., Farringdon Avenue, E.C. 4, exhibit, *inter alia*, kinema projectors, and samples of the "Klimax" parallel arc for studio work, projection, &c.

N.A.S.E's New Address.—The registered office of the National Association of Supervising Electricians is now at Room 29, Metropolitan Buildings, 63, Queen Victoria Street E.C. 4. Telephone, "City 7381."

New French Companies.—Under the style of Etablissements Nioca has been formed a company at Paris (Rue Volney, 6) for the manufacture, sale, and purchase of electric porcelain and other articles of electric equipment. The capital is 1,120,000 fr. in 500-fr. shares, of which 1,800 are apportioned to MM. Moatti, as consideration for their assets.

Le Micalas (Société Française des Isolants pour l'Electricité) is the title of a recently-formed company for the manufacture of and trading in electric insulators and the accessory chemical products. The capital is 6,000,000 fr. in 100-fr. shares, of which 24,000 A shares are allotted to M. Herrmann in partial payment for his assets. Offices, 6, Rue Volney, Paris.

There has been embodied at Paris (66, Avenue de la Bournnais) the Comptoirs d'Electricité Industrielle (Anciens Etablissements de la Motte-Rouge), for the working of the goodwill of an electric furnisher's business. The capital is 300,000 fr., of which 2,300 100-fr. shares are allotted to MM. Motte-Rouge and De Pontaumont as compensation for their assets.

The Société Luxembourgeoise pour Enterprises Electriques is the name of a company formed at Paris, with a capital of 3,000,000 fr., to trade in electric material of all kinds.

Engineering Wages and Conditions.—According to the *Manchester Guardian*, the Engineering Employers and Unions recently met in conference to discuss in the first place certain actual disputes which had arisen about overtime, manning of machines, and the apprentice question. These disputes led to a number of local stoppages in particular factories. In the second place the conference was expected to discuss the employers' application for a general reduction in wages throughout the industry. When the conference met the employers apparently asked the Unions whether they would agree to recommend a general resumption of work in the factories in which stoppages had taken place over these questions. To this the Unions refused to agree. The employers thereupon intimated that, in their view, this created a serious situation, that full powers of action had been placed in the hands of the Federation by the constituent associations, and that they would have immediately to consider their position. They thereupon adjourned the conference without any discussion on the wages question.

"The view in Trade Union quarters is that this means that a serious crisis, in which the wage reduction question will inevitably become the principal issue, whatever the ostensible cause of the dispute may be, is imminent."

Scottish Electricians' Strike.—The strike of electricians in Scotland is now in its seventh week. No conference between the two parties has been held. The employers throughout Scotland, states the secretary of the Electrical Contractors' Association of Scotland, have recently been advertising for men at the new rate of 2s. per hour, and there has been a considerable number of responses. Some firms are already fully staffed. There is no doubt that a very considerable number of those who have applied are not members of the Electrical Trades Union, but, on the other hand, it seems clear that members of the Union are also seeking employment at the new rate. Practically the whole of the employés of one large firm returned to work on April 15th, and it is reported that the employés of another firm returned on April 12th, both at the new rate.

Mr. Higgins, the district organiser of the E.T.U., points out in connection with this statement that, so far as the members of the Union are concerned, it is not true. He admitted it might be true that some employers were able to engage men, but those were non-Unionists. What the employers desired most was competent electricians, and Mr. Higgins said he doubted whether those men were competent workers. So far as Glasgow was concerned, he said no firm had succeeded in securing a full staff.

Social Events.—At the invitation of the Mayor of Leigh (Mr. Geo. Holden), Callender's "Anchor" Works Musical Society recently gave two performances of Gilbert and Sullivan's opera, "The Pirates of Penzance," in the Leigh Hippodrome, in aid of the local infirmary. This laudable effort resulted in the Mayor, on behalf of the Infirmary Board, receiving a cheque for £302, representing the gross proceeds of the evening's entertainment. The whole of the expenses (£110) were defrayed by private subscriptions, thus avoiding the heavy entertainment-tax. In acknowledging the cheque, the Mayor highly complimented the "Anchor" Works Musical Society on their excellent performances. The interest in the event was enhanced by the fact that, with the Society's double set of principals, two "houses" were run during the evening to crowded audiences. Mr. Alec Hill (conductor), Mr. Jos. Hull, A.R.C.O. (accompanist), Mr. W. T. Thornley (stage manager), and Miss Castles (who was responsible for the costumes), together with the principals and chorus, were the recipients of well-merited congratulations. The arrangements were carried out by a Town Committee, with the Mayor as chairman, Messrs. J. A. Smith and W. Hulme Jones (hon. secretaries), and Mr. W. Higenbottom (hon. treasurer).

The staff of the Midland Electric Manufacturing Co., Ltd., have formed a Staff Social Club, and held their first dinner and musical evening at the White Horse Hotel, Birmingham, on April 14th. Over 40 members were present; Mr. W. L. Barber (managing director) presided.

The annual dinner of the Willesden District Council Electricity Department was held at the Social Club Room, Salusbury Road, Kilburn, on Saturday, 9th inst. Councillor W. A. Hill, the chairman of the Electricity Committee, who presided, was supported by Mr. A. W. Blake, and members of the Electricity Committee and other friends, including Messrs. W. Wyld, borough electrical engineer of Hampstead, H. Howard, and R. Hughman. The party numbered approximately 80. Unique table decorations were devised by members of the staff. The toasts included "The Electricity Committee," "The Officers of the Council," and "The Visitors." In responding to the toast of "The Electricity Department," Mr. Blake gave a brief *résumé* of the work of the department during the past year. Twenty-one miles of new cable had been laid, 473 new consumers had been added, and the electric vehicle department had completed its first full year of working. Of the 14 electric vehicles which were operating on house refuse collection in the district, one had run without any loss of time whatever throughout the 12 months, one lost ½ hour, one lost 1 hour, one 2 hours, and one 2½ hours, and taking the whole 14 vehicles, the whole time lost was only 99½ vehicle hours, which represented only ·3 per cent. of the whole working time. He instanced this as a record which would be hard to approach by any other form of road transport. The plant at the Acton Lane Garage was also being used for charging industrial trucks and other electric vehicles, and the increasing use of these in the factories of the districts showed that the great advantages of these trucks in the handling of goods were being more and more realised by manufacturers. A much-enjoyed musical programme was contributed by various members of the staff.

The concluding social evening of the Ediswan (Bristol) Staff was held at the company's showrooms on the 6th inst. A varied programme was given by members of the staff and their friends.

E.D.A. Activities.—The Electrical Development Association, Hampden House, 84, Kingsway, W.C. 2, has recently published two interesting articles upon Switzerland. One (E.D.A. 152), deals with electrical enterprise in that country, and the other (E.D.A. 155), is an abstract of a lecture delivered by Herr Paul Beuttner to a Society of Engineers in Switzerland. This deals with electric heating by "heat accumulation" methods using high load-factor appliances.

Salaries in Electricity Works.—We regret to learn from the minutes of the Hammersmith Borough Council for April 20th that the Salaries and Wages Committee (No. 2) has recommended the withdrawal of the Council from the various Joint Industrial Councils and Boards representing employers and employés, and proposes instead to hold conferences with representatives of the Council's staff and employés.

Lead.—In their report, dated April 16th, Messrs. James Forster & Co. state :—"The market for lead, as for other metals, has been remarkably steady, notwithstanding the gravity of the labour difficulties, but the position is very artificial, and the steadiness is certainly not due to trade demand, which has been of a most meagre description. Not only is the consumption of lead for building trades much less than it was, but the electrical cable trade has fallen off considerably during the last month or so."

Undergrounding of German Overhead Wires.—It is expected that the long-distance cable connections between Berlin and Rhineland will be completed in the next few months. In connection with this work it is stated that as soon as the financial situation will permit, the German telegraph authorities propose to substitute cables for the most important Press and telegraph wires. In order that all technical experience may be utilised in the construction of cables, and also secure the greatest possible economy and efficiency by simplification, it is intended to form a company under the title of the Deutsche Fernkabel G.m.b.H., of Berlin, with the co-operation of the State and the firms to be entrusted with the manufacture. Hitherto only the Siemens & Halske Co. has supplied long-distance telephone cables to the telegraph authorities. The Felten & Guilleaume Co. and the A.E.G. will now participate in the new company, which will also embody other cable makers later on.

Italian Electrical Preparations.—In the course of the report for 1920 of the Società Anonima Italiana Gio. Ansaldo e Cia., the directors state that the company's programme covers a series of manufactures in mechanical and electrical engineering and shipbuilding, complemented by the production of special qualities of electric steel. Dealing with the transposition from war to peace work, the report mentioned that the Sampierdarena works is producing turbines, marine boilers, and locomotives. The artillery works of Vittoria had been transformed into a great works for the construction of three-phase machinery and electric locomotives, while the old electrical workshops remained intact for the building of continuous-current machines. The great railway transformation which the country was preparing for the substitution of electric for steam locomotion and the necessity for the carrying out of new hydro-electric works would feed these establishments with work. The electric steel plant at the Aosta works and the sheet-rolling mill were now in full operation, and one of the two electric blast furnaces would soon be able to start production.

Belgian Cable Works.—The report of the Société Belge pour la Fabrication des Cables et Fils Electriques states that the results obtained in 1920 show that the company was not affected by the crisis which in the second half of the year succeeded the period of prosperity in 1919. During the year a copper-drawing mill was added to the cable department, permitting of a considerable increase in the production of insulated wires and cables, and a reduction in the prime costs. As it had been impossible to recover many of the machines requisitioned in this department by the Germans, the directors had obtained substitutes for some of them. The department for insulating tubes had been extended as a result of the recovery of all the machines which had been seized, especially the cold rolling mill, shears, &c., which were again placed in service during the year, together with others constructed for the company. The net profits earned in 1920 amounted to 1,248,000 fr., and a dividend at the rate of 45·62 fr. per share had been declared.

N.F.E.A. Dinner.—At the annual dinner of the Bradford branch of the National Federated Electrical Association recently, when the President of the Association (Mr. Percy Collinson, of Bradford), and the general secretary (Mr. L. G. Tate) were present, and at which Mr. A. Smith presided, Mr. Douthwaite, of the Electrical Factors, responding to the toast of "The Guests" (proposed by Mr. Harry Moss), suggested the establishment of an Electrical Club in the city, open to all engaged in any branch of the electrical industry. In proposing "Success to the Bradford Corporation Electricity Department," Mr. Collinson congratulated Bradford upon the harmonious relationships between the municipal undertaking and the electrical traders. Mr. C. E. Allsop, of the Department, responded. "The Contractors' Association," was proposed by Mr. J. Dyson, and replied to by Mr. Tate.

The E.P.E.A. and the Strike.—On April 14th the E.P.E.A. issued to the Press the following announcement as to its position and intentions :—

In connection with the present crisis the Electrical Power Engineers' Association desires it to be made clear that it does not propose to withdraw its members. After a conference with the London District Committee of the Electrical Trades Union it has decided to issue the following instructions to its members :—

1. That members of the E.P.E.A. employed on railway or tramway systems will carry out their normal duties only, and not do the work of any employé on strike nor supervise or instruct any volunteer labour that is introduced.

2. That, in respect of the electricity supply stations, the members of the E.P.E.A. will maintain, supply and use every endeavour to prevent this industry being involved in the present dispute. Before any action is taken which is likely to affect the electricity supply industry, a conference of the Unions concerned is to be called.

To Confer with the Chancellor.—On Thursday the Chancellor of the Exchequer was to meet representatives of the Federation of British Industries and the Association of Chambers of Commerce in order to discuss the valuation of stocks and other questions arising out of the termination of E.P.D.

The Trade of Siam.—The Department of Overseas Trade has issued a report (H.M. Stationery Office, 1s. 3d.) on the commercial situation in Siam at the close of 1920. It has been prepared by Mr. T. H. Lyle, C.M.G., H.M. Consul-General at Bangkok. The situation of the import and export trade is reviewed, as are such matters as shipping, railways, aviation, and company developments. Importations of iron, steel, and machinery, which ceased entirely during the war, show encouraging signs of restoration.

In "metals of all kinds in the rough," there is a steady increase in the United Kingdom direct import, while Japan shows a marked movement in the reverse direction. The United Kingdom share in machine tools increased from a merely nominal sum to ticals 49,200 (£4,360), but failed to overtake the United States at ticals 73,728 (£6,536). For the year ended March, 1914, the United Kingdom provided 52,620 ticals' worth (£4,047) of machine tools out of a total import of ticals 59,918 (£4,609). In machine belting there was a general decline, though the United Kingdom still retained four-fifths of this business at ticals 247,588 (£21,949). Other branches of metal manufactures in which the United Kingdom proportion showed satisfactory increases were bars and sections, sheets and plates, galvanised sheets (from nil to ticals 440,363, or £39.039), wire and manufactures thereof, screws and rivets, cutlery and tools, and railroad material. In most of the items herein enumerated, corresponding decreases occurred in the shares of Japan and the United States, save that Japan, with 142,285 kg. valued at ticals 210.216 (£18 639) doubled her quantity of enamelled goods as compared with the previous year, and the United States partook of the general increase in sheets and plates, screws and rivets, railroad material, and cutlery and tools.

There is a satisfactory increase to ticals 264,295 (£23,430) in the United Kingdom share of electrical goods and apparatus, apparently at the expense of Holland and Japan. In this branch, Sweden is this year amongst the prominent suppliers, with a total of ticals 266,291 (£23,607), due to the purchase in that country of a new turbine plant by a public utility company in Bangkok which is responsible for much of the electric lighting and tramway power of the port. The United States, with £41,175, is responsible for one-third of the total imports of electrical goods, an increase in value on last year's figures, though the actual quantity of goods supplied is reduced by 55,000 kg.

The reduction of telegraph rates between Siam and India and Burma commenced to take effect on August 1st, 1920. Previously the rate had been 75 cents per word to India and 65 cents to Burma. Henceforth the charge is to be 45 cents in the case of either India or Burma. The Siamese Ministry of Marine proposes to establish, by way of experiment, a wireless installation on the outer Red Lightship at the bar at the mouth of the Menam river to enable incoming ships to communicate with Bangkok, in conjunction with the naval wireless station. An attempt is also to be made to introduce night signalling from the same lightship to show ships entering or leaving what depth of water there is on the bar.

The Trade of Finland.—A report has been issued by the Department of Overseas Trade on the economic, financial, and industrial conditions of Finland. The pulp, timber, textile and other industries are reviewed. The total production of the engineering works in 1919 is put down at 236,349,600 Finnish marks; lighting and power transmission, 52.293,100 ditto; tools, 1,030,000 ditto. During 1920 Finnish industries did very well on the whole. The metal industry suffered much from the lack and high cost of raw materials, increased wages, and high price and scarcity of coal. Among other matters it is mentioned that a large water-power station is being built at Ämsä, about 70 km. east of Bjorneberg. About 7,000 h.p. will be transmitted to the industrial establishments at Bjorneberg. The power station, which is being built by the Bjorneberg Power Co., with a capital of 2,000,000 Finnish marks, is expected to be ready in April, 1921. In the railway construction programme for 1921 there is a sum of 350,000 Finnish marks assigned for planning the complete electrification of the railways in Finland. The imports for the first nine months of 1920 included :—Electrical machinery, 773,842 kg., 15,470,680 Finnish marks; insulated wire, cables, &c., 370,042 kg., 6,447,377 marks; electric glow lamps, 75,888 kg., 6,888,754 marks; steam engines, 168.931 kg., 1.505,640 marks; water turbines, 53.031 kg., 406,233 marks. The machinery, turbines, and appliances imported were received chiefly from Germany (78,793.021 Finnish marks), and from Sweden (53,245,352 Finnish marks); Denmark came next with 6,820,154 Finnish marks. Metals and metal-work entered chiefly from Germany, Sweden, Great Britain, U.S.A., and Danmark.

Reduction in S. African Railway Rates.—The South African Railways and Harbours Administration announces that, with effect from Monday, April 11th, a reduction of 1s. per 2,000 lb. has been made in the net railway rates to Union ports and Delagoa Bay on export coal shipped beyond South or South-West Africa, and coal used for bunkering ships carrying a full cargo of export coal beyond South or South-West Africa.

Wages in the Rubber Industry.—Flat Rate Cut Preferred.—Employers in the india-rubber manufacturing industry have proposed a decrease of payments by 10 per cent. all round. To discuss the question a conference between the Manufacturers' Association and the Amalgamated Society of India-rubber Cable and Asbestos Workers was held in Manchester. The workers' representatives pointed out that if a reduction was inevitable it should be of a uniform sum of money which all could afford. A fortnight's postponement was agreed to.—*Manchester Daily Dispatch*, April 12th.

Platinum Production in British Columbia.—The production of platinum, it is believed, will soon be greatly increased in British Columbia, investigations conducted during a number of years having disclosed the fact that the Fraser River and adjacent territory constitute one of the principal platinum deposits of the world. A plant is being erected, and it is expected reduction work will commence in the spring. It is believed that for 250 miles along the Fraser River and 150 miles on tributary streams 75 per cent. of the black sand deposits can be dredged, and concentrates to the extent of 8 to 40 lb. per cb. yard of earth obtained.—*Reuter's Trade Service* (Victoria, B.C.).

Neuhausen Aluminium Industry.—The report of the directors of the Aluminium Industrie A.G., of Neuhausen, refers to the obstacles experienced in obtaining raw materials in 1920. Although relief had been perceptible for so memonths past, the difficulties continued in consequence of economic measures in surrounding countries. The works in German Austria had again been set in operation. During the final months of 1920 the effects of the general business crisis were also felt by the company. A severe decline in prices had been produced through the stagnation in sales and the pressing offers made specially by the new works which were established during the war, and the price fall had not yet come to a standstill. Coming to consider the company's interests in France, the report states that the directors had succeeded in securing the removal of the sequestration of the works and in recovering the management, with the co-operation of French friends. An order had also been obtained for the removal of the wartime requisition of the works installations and of individual mines, and the directors hoped to secure the execution of this decision at an early date. Including the balance forward, the accounts show net profits of 7,629,000 fr., as compared with 8,821,000 fr. in 1919, and it is proposed to pay a dividend at the rate of 16 per cent. on share capital of 42,000,000 fr., as against 18 per cent. on the same amount of capital in 1919 and 20 per cent. in each of the four preceding years.

The Russian Electrical Industry.—The official Soviet gazette, *Pravda*, of Moscow, publishes some interesting figures regarding the electrotechnical industries in Russia. According to this journal, the Erikson works turned out 10,000 pieces of telegraph apparatus in 1916; at present it is turning out only 250. The Russian Siemens-Schuckert works formerly supplied machinery to the extent of 24,000 kW a year; at present it is scarcely 6,000 kW. The cable works formerly used about 250,000 Russian poods of copper per year; the present use is only about 25,000 poods. The Russian branch of Siemens & Halske formerly supplied 7,500 Morse instruments per year, while to-day the production has decreased to only 150 instruments. Measuring apparatus, radio-telegraphic apparatus and similar articles are not manufactured at all. The Soviet authorities are making great efforts to obtain the necessary workmen for the electrotechnical industries, for the telephone, as well as the telegraph, service is in a most deplorable condition. It is stated that the want of men is chiefly responsible for the conditions prevailing in the electrotechnical industries. In former times more than 30,000 hands were employed in these industries; to-day there are scarcely 6,000. Formerly nearly 70 per cent. of the workmen were skilled labourers; at present hardly 10 per cent. are skilled. The paper adds that in the district of Peterhof, where the large Putilow works are situated, the whole telegraph and telephone service is entirely out of order, and no communication is possible. On account of lack of material and skilled workmen no repair work can be undertaken.—*Electrical World.*

New York Electrical Show.—The New York Electrical Exposition will be held during the 10 days beginning September 28th. As in former years the show will display electrical equipment for the home, motor-driven machinery for industrial purposes, electrically-operated material-handling machinery and electric vehicles.—*Reuter's Trade Service.*

Lamp-bulb Makers' Propaganda.—Over 600 members of Parliament each recently received a mysterious little package which looked as though it might contain a belated Easter egg; in reality, each case contained a perfectly good electric lamp bulb made in England [not a complete lamp, but only the globe of fine glass], and they had been sent by the British Chemical Ware Manufacturers' Association by way of proof that English manufacturers and workmen were capable of producing that delicate glass work. The plea was for protection from the dumping of foreign bulbs at low prices made possible by the difference in money values in England and on the Continent. "This country uses up 1,000,000 electric lamps a week," said Mr. T. Lester Swain, the Secretary of the Association, to an *Evening News* representative. "Our factories, of which eight are still struggling on against the foreign competitor, can turn out, of course, not only the glass bulb, but the complete lamp. All the Government proposes to do is to put a 33⅓ per cent. duty on imported bulbs and lamps; but that, which is a provision of the Key Industries Bill, is not enough. If the English industry, which could give much more employment, is to be saved, we want prohibition of the foreign article, for a time at any rate, and now the manufacturers mean to take every means of reminding members of Parliament of what they regard as the Government's duty to an infant British industry."

For Sale.—Todmorden Corporation Electricity Department wants offers for surplus generating plant, including two Bellis & Morcom compound engines, generators, two Lancashire boilers, superheaters, shovel stokers, piping, &c. Winchester Corporation Electricity Department has for disposal one 225-kW d.c. Bellis-Mather & Platt generating set. See our advertisement pages to-day.

The Swedish Jungner Accumulator.—The report of the Svenska Ackumulator A. B. Jungner states that an increased turnover took place in 1920, notwithstanding the long strike at the beginning of the year. New markets for Nife accumulators had been found, among others, in connection with ship installations and wireless telegraphy, and the batteries were being increasingly used for electric transport arrangements, and train lighting, for which large orders were received. The company's English subsidiary had also worked successfully. Among others, contracts had been concluded for large annual deliveries of batteries for mining lamps. The Norwegian subsidiary had obtained orders for train lighting batteries for the Norwegian State Railways. The accounts show net profits and balance forward, amounting to 841,000 kr., and it is proposed to pay a dividend of 16 per cent. on the preference shares, and 8 per cent. on the ordinary shares, this result comparing with 18 per cent. and 10 per cent. respectively in 1919.

Census of Production Postponed.—In view of the urgent need for economy, the Government has decided not to proceed with the Census of Production, of which notice was given in the Order of the Board of Trade dated December 22nd, 1919. A census in 1923 in respect of the production during 1922 is in contemplation, and should this be decided upon, an Order under the Census of Production Acts will be laid before Parliament in the course of the current year.—*Board of Trade Journal.*

Inquiry.—A correspondent asks for the name and address of the manufacturers of "Litho Premier" non-shock switches.

LIGHTING AND POWER NOTES

Barnsley.—Proposed Mains Extensions.—The Electricity Committee has recommended the Corporation to seek sanction to a loan of £22,000 to defray the cost of mains extensions in the Huddersfield Road district.

Belfast.—Progress of Extensions.—At a meeting of the City Council, the Electricity Committee was criticised for accepting a tender, in connection with the new power station buildings, which was considerably in excess of other tenders. The chairman of the Committee explained that the action was taken on grounds of expediency and urgency, and the minutes were adopted. It was also stated that a 6,000-kW generator had been installed, and only half the necessary boiler power had been provided. It was explained that the installation of a 12,000-kW generator was being expedited, and that the course taken with regard to temporary boiler power was the most economical.

Blackburn.—Proposed Extension of Supply.—The Rural District Council has passed a resolution supporting the request of prospective users of electricity in its area. The Corporation proposes to obtain powers to extend its cable to various parts of the rural district to meet the demand.

Carlisle.—Loans.—The Town Council has received sanction to a loan of £5,300 for electric lighting work in connection with the housing scheme, and a loan of £9,705 for switchgear, water circulating system, &c., has been applied for. It is proposed to install temporarily a 3,000-kW turbo-alternator at an estimated cost of £40,000, pending extensions of the works on a new site.

Carmarthen.—Increased Charges Approved.—The Carmarthen Electric Light Co., having applied to the Town Council for higher public lighting rates, a sub-committee was appointed to inspect the company's accounts. This committee reported to the Council on April 12th that it had compared the average cost of production for the three years 1912-14 with the cost for the three years 1918-20, and found there was an increase of about 70 per cent. It therefore recommended the Council to grant the company an increase of 70 per cent. over the original contract; the recommendation was adopted.

Chester.—Important Scheme.—Mr. S. E. Britton, the electrical engineer of the Chester Corporation, has prepared a report on the scheme for the utilisation of H.M. Factory at Queensferry for the supply of electricity. The full rated capacity of the apparatus installed at Chester is 2,170 kW, which, with one set in reserve, is capable of meeting a demand of 1,890 kW, provided that the batteries are maintained in a condition which will produce their rated capacity. At present there are additional demands waiting for a supply amounting to 400 kW. There are three methods of providing additional capacity:—(1) To complete negotiations with the War Office for a supply from H.M. Factory at Queensferry, where there is installed plant capable of generating 5,500 kW; (2) to obtain temporary oil-driven plant and install it at different parts of the city where the demand for electricity is greatest; (3) to install additional plant at the New Crane Street works. The Chester Electricity Committee has recommended the City Council:—(1) To authorise the Committee to effect an agreement with the War Department for a supply of electricity in bulk from the factory; (2) that application be made to the Electricity Commissioners and the Ministry of Transport for the latter to install transformers at the factory, and to erect a transmission line from the factory to the New Crane Street Works at an estimated cost of £21,800; (3) that application be made to the Electricity Commissioners for sanction to borrow £24,500 for providing converting plant, sub-stations, and underground cables for the distri-

bution of electricity in Chester; (4) that the Committee be authorised to (*a*) arrange terms and conditions with the Commissioners and the Ministry of Transport with regard to the provision and maintenance of the transformers and transmission line, and (*b*) to enter into contracts for purchasing the converting plant and cables, and for the erection of sub-stations and works. Another recommendation is to the effect that, in the event of the Ministry of Transport being unable to install the transformers and the transmission lines, application be made to borrow £21,800 for that purpose, and the Committee be authorised to enter into the necessary contracts.

Continental.—France.—A far-reaching scheme, destined to effect 20 Départements, including that of the Seine, and as a consequence, Paris itself, is that associated with the recent visit of the President of the Republic, accompanied by the Minister of Public Works, to the site of the projected barrage on the Rhone at Génissiat, for a 200,000-h.p. electrical installation. Soundings are taking place to ascertain if the subsoil possesses the necessary strength, &c., to bear the projected massive 120-metre high dam wall. Should the result be unsatisfactory, recourse will be had to another site, near Malpertius, where the outflow from Lake Leman passes.

The Société Force et Lumière des Pyrénées has been granted a concession for the distribution of electricity in 17 communes of the Upper Pyrénées.

Financial difficulties and the bad faith of Germany in the matter of reparation payments notwithstanding, the French Chamber, by a recent law, is doing its best to meet a pressing situation by authorising the erection by State departments of a high-pressure system of electricity supply in the devastated departments in the North and East of France. The law is applicable to the whole of France, but, for urgent reasons, its principles are to be first applied in the regions ravaged by the German invasion. Generating stations are to be set up at the most favourable spots—waterfalls, mines, ironworks, &c.; further, it is intended that all these stations shall be linked with one another, and with the various distribution centres, and that these works shall be carried out by the State or by private individuals, under the control of the State. The general scheme provides for a reduction of the number of generating stations, and an increase of their productivity. Each working company or group of *concessionnaires* will have to carry out the general plans on lines laid down by the Government, which will advance a part of the outlay whether for the repair of partly destroyed or newly erected stations and systems. The State undertakes to complete the new station of Hirson, partly built by the Germans. The transmission lines will run from Lille to Paris, and from near St. Dizier to Chambley in Lorraine, having a total length of about 1,500 km.

Ealing.—Disposal of Street Lamps.—The Town Council offers 22 arc lamp standards now in Uxbridge Road to any firm that will remove them and reinstate the pavement free of charge. The Council has also decided, with a view to economy, that street lamps shall not be lighted in Ealing, except in the main roads, during the summer months. About £650 will be saved.—*The Times.*

Edinburgh.—House Lighting.—The Housing Committee of the Corporation has decided to adopt electricity as the illuminant in the houses in course of erection at Willowbrae.

According to a statement made at a meeting of the electorate by the Convener of the Electricity Committee, the new electricity undertaking is expected to cost about £1,750,000.

Objection has been made to the supply of electricity for lighting and gas for cooking for the houses being erected by the Corporation, on the ground of the cost of installing both services. It has been found impracticable to light low-ceiling houses with gas. The question of the double service has arisen all over the country. Under the statutes, neither the gas nor the electricity department is under obligation to lay mains, and this is being pointed out to the Ministry of Health.

Glasgow.—New Sub-Stations.—At a meeting of a special Sub-Committee of the Electricity Committee the manager reported that the property in Elliott Street for a sub station could be acquired for £12,000, and that the estimated cost of erecting a new sub-station on the ground in Lancefield Street was £21,500, that the additional cost of laying cables to the site would be £5,000, and that, after making allowance for the cost of alterations and improvements on the property in Elliott Street, there would be a saving of £7,000. The special Sub Committee, after carefully considering the proposed purchase, agreed to recommend that an offer of £12,000 be made for the property.

Hove.—Loan.—The Electricity Commissioners having intimated that they are prepared to approve a loan of £7,600 for the provision of h.p. mains between the North Road sub-station of the Brighton Corporation and the Hove station in Davigdor, formal sanction is being sought to the borrowing of this amount.

India.—Resistance to Reservoir Scheme.—In connection with the new Tata hydro-electric scheme near Poona, which includes the construction of a great reservoir for the supply of water power, there has been a strong movement of protest on the part of the inhabitants of the area which is to be submerged, and who will thus have to remove from their villages and farms. They are now offering passive resistance to the progress of the operations by lying on the ground where the labourers are working, with the result that constructional work has practically been brought to a standstill.—*Reuter* (Bombay).

Liverpool.—Economy Measures.—On April 15th severe restrictions upon the use of electricity were put into force. Its use in kinemas and other places of amusement is confined to the hours from 6.30 to 10.30 p.m. Electricity for power purposes must only be used from 10 a.m. to 4 p.m., and from 10 p.m. to 6 a.m. The tramway services are only run from 7 to 10 a.m., from noon to 2 p.m., and from 4 to 11 p.m.

London.—St. Marylebone.—The Electric Supply Committee has decided to postpone the proposed transfer of the eastern district sub-station from Rathbone Place to a position nearer the centre of the load. Protective devices for two e.h.p. cables are to be installed at the existing sub-station at a cost of £81.

Luddendenfoot.—House Lighting.—The District Council has considered terms proposed by the Sowerby Bridge District Council for a supply of gas for houses of the Warley Wood scheme, and as a result has decided that an estimate of the cost of electricity in place of gas be prepared. It was resolved also that when the Housing Commission approved the substitution of electricity for gas, application should be made to the Yorkshire Electric Power Co. to supply electricity for light and power at £3 per house, plus 2d. per unit, for the 20 houses on the site until the Electrical Distribution of Yorkshire, Ltd., could supply on general supply terms. The Council decided to support the application of the Electrical Distribution of Yorkshire, Ltd., for an order to supply the Luddendenfoot area.

Midlands.—Electricity Supply.—At a meeting at Birmingham on April 14th of the Standing Committee of the District Joint Industrial Council for the Electricity Supply Industry, representative of the employers and employés of various undertakings throughout Warwickshire, Staffordshire, Worcestershire, and Shropshire, it was made quite clear that the constituent parties would be called together before the electricity undertakings in the area would be affected by the action of the Triple Alliance.—*Morning Post.*

Monaghan.—Electric Light Scheme Abandoned.—At the recent monthly meeting of the Urban District Council various estimates of the cost of the proposed electric lighting scheme were considered. It was stated that the expenditure would involve the imposition of a rate of 10d. in the £, and it was decided, therefore, to take no further action in the matter.

Newark.—Opposition to Scheme.—Arising out of the Corporation's proposal to proceed with an electricity scheme at an estimated cost of £200,000, a number of firms, which hold that the present is an inopportune time for any avoidable expenditure, have intimated their refusal to take supplies on the terms quoted.

New Zealand.—Lake Coleridge.—Referring to the diversion of the Harper River to augment the volume of water in Lake Coleridge, the Minister for Public Works recently stated in Christchurch that the work was being pushed on with all haste. The present intake at Lake Coleridge took in 110 cb. ft. per second, which was too heavy a drain on the resources of the lake in its present state. It was expected that the Harper diversion would be so far completed within a month as to allow the water to enter the lake. The extra volume of water thus obtained would be sufficient to deal with all immediate requirements made by the electrical system, and would also be instrumental in bringing the lake back to its original level. There would be sufficient water to meet the demand to be made in connection with the installation of the new plant, through which another 4,000 h.p. would be ready to supply to consumers by June. With a regular supply of water by the diversion, said the Minister, he was assured by the engineers that no further diversions would be necessary even when the system was developed to its ultimate capacity of 40,000 h.p.—*Auckland Weekly News.*

Rochester.—Grant to Company.—The Town Council has decided to pay the sum of £400 to the Kent Electric Power Co. in respect of its contract for installing electric lighting in High Street. The contract price was £570, but owing to the war the actual cost was £1,223, and the £400 granted is in respect of the loss of £653 on the work.

Rotherham.—Opposition to Order.—At a meeting of the Electricity Committee, the Town Clerk reported that the Electrical Distribution of Yorkshire, Ltd., had made application to the Electricity Commission under the Electricity (Supply) Acts, 1882 to 1919, for a special order empowering it to supply electricity in, amongst other areas, the Rotherham and Wortley Rural Districts. The Committee recommended that the Town Clerk be instructed to take the necessary steps to oppose, on behalf of the Corporation, the application made for this order.

Runcorn.—Progress of New Station.—The Mersey Power Co. has made substantial progress with its new power station at Percival Lane, Runcorn, and it is expected that the energy will be available in August next. It is further hoped that the transmission cables to Ellesmere Port will be completed, and power supplied there in June. The higher costs involved by the past delays and the large extensions required to meet the growing demands will, it is stated, necessitate the raising of more capital by the company in the near future.

South Molton.—Proposed Water-power Plant.—The Town Council, on April 12th, discussed the possibility of utilising water-power for generating electricity. Mr. Stewart, electrical engineer, of Barnstaple, said that the water at the Collar Factory would be sufficient for the greater part of the year, if it were used only for lighting the town; it would not be sufficient for the town and the factory.

Stretford.—Cost of Extensions.—At a meeting of the Electricity Committee, the clerk and consulting engineer reported upon an interview with the Electricity Commissioners relative to the Council's application for sanction to electrical extensions. Consequent upon the modifications which had been made in the estimated expenditure on new works, the approximate cost of the proposed extensions had been reduced to £157,000, details of which were explained by the consulting engineer.

Sunderland.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to borrow £20,000 for mains work. It is intended to expend at present £15,928 on a low-pressure network.

Uruguay.—Water Power.—The idea of utilising the Salto Grande waterfall for the generation of electrical power has been revived recently. It is estimated by technical experts that the power obtainable from this source would benefit more than half of the Republic.—*Review of the River Plate.*

Winchester.—Loans.—The Town Council has applied for the following loans:—Feeder and distribution cables, £3,500; 450 kW turbo-generating set, £11,000; "Olipel" remote control gear and switches for street lighting, £1,200; mains and services, £3,000; meters, £2,500.

Woodstock.—New Works.—The Electric Light Co. has commenced the establishment of works at Hoggrove Hill, and it is hoped to have a supply of electricity available by October.

Worthing.—Report Required.—The Electricity Committee has asked the electrical engineer to report the capacity of, and the probable additional demands upon, the generating plant at the electricity works, and the desirability of installing new plant to meet the requirements of the undertaking in the future.

Wrexham.—Colliery Plant Destroyed.—Damage estimated at £30,000 was caused by fire on the 18th inst. at Plas Power Colliery, near Wrexham, one of the largest in the North Wales coalfields. The outbreak occurred in the power station, and the whole building and its contents were destroyed. This power station feeds two other collieries, and it will be several months before the three collieries can be got ready for work again. The outbreak is said to have been caused by a workman dropping a lighted match into the well of the fly-wheel.—*The Times.*

TRAMWAY AND RAILWAY NOTES.

Carlisle.—Proposed Postponement of Track Removal.—At a meeting of the Highways Committee it was reported that the Carlisle Electric Tramways Co. had written suggesting the postponement of the removal of the double track over Eden Bridge from its present position to the centre of the roadway, owing to the excessive cost of labour and materials, and in view of the coming decline. The Committee resolved that a reply should be sent requesting the company to commence the work not later than June next, on the assumption that it will be completed within three months from the date of commencement.

Continental.—Italy.—The Italian Government has perfected plans for the electrification of 4,000 miles of the State Railways and certain of the privately-owned systems. The project will involve the outlay of 800,000,000 lire (nominally £32,000,000), and the time required to complete the undertaking is estimated at 10 years. The construction will be taken in hand partly by the State Railway Administration, and partly by private firms under the immediate direction and supervision of the Ministry of Transportation.

Before the whole plan could be adopted, many difficult technical questions had to be decided, and some variation of the accepted project may yet have to be considered. The first work will be the extension of the three-phase 16-cycle system now in use on the lines already electrified.

Electric traction is giving results so satisfactory, particularly in the case of lines crossing the mountains, that the State Railways have trebled their traffic.

Owing to the wide variation in the voltage and frequency of the electricity produced in Italy, 46 per cent. of which is 42 cycles, and 41 per cent. 50 cycles, the State Railways, up to the present, have required the construction of special power plant to supply 16-cycle power. In connection with the plans now adopted this policy will be discontinued, and provision made for the conversion of the available power to the required type. The present type of electric locomotive not being deemed entirely suitable for the purpose, special designs are being prepared for locomotives adapted to the two new systems with which experiments will be conducted. Already standard types of overhead equipment have been established, and it is intended to place all orders for such manufactures with Italian firms wherever possible. Many firms which mean to tender have already extended their plant with a view to increasing their productive capacity.

The consulting engineers of the State Railways are of opinion that, for the most part, the power required can be provided by the power plants already in existence or now in course of construction. It will be necessary to erect a few powerful hydro-electric stations and their construction will be undertaken by the State in certain localities in order to fill in gaps in the existing system, and to provide a suitable reserve. Competitive bids will shortly be invited from private firms for other lines, in order that the maximum amount of progress may be made. The object of the Ministry of Public Works is to amalgamate the interests of the State-owned and privately-owned lines, so that a minimum electrification of 500 km. of the lines in the kingdom shall be completed each year. —*Reuter's Trade Service* (Milan).

France.—The Municipal Council of Paris has ratified the proposals of its Commission for the deferred taking over of the Compagnie du Métropolitain Railway. By the new arrangement the company becomes a simple manager, interested, however, to a certain extent in the good results of the working, and the city undertakes the completion of the network and the payment of its bonds. The company is assured a net return of 11,500,000 fr. per year at the lowest, rising to upwards of 14,000,000 or 15,000,000 fr., according to the forecasts of the traffic and of the lowering of the cost of coal. A sum of 26,000,000 fr. has been disbursed by the city to the company in settlement of the charges of the war.

Darlington.—Deficit.—Sir Charles Starmer reported on April 7th that the tramways revenue during the past 12 months showed an increase of £5,542, while the actual loss had been £3,156, as against an estimated loss of £2,000. The difference between the amounts was largely accounted for by extra track repairs costing £500, and a loss of £500 revenue, mainly due to unemployment. Unless something unforeseen occurred, he had every reason to hope that during the ensuing year the income would balance the expenditure.

Durham.—County Council's Bill Rejected.—On April 14th the Bill in which the Durham County Council seeks powers to construct tramways, &c., was considered by the House of Commons. The opposition to the measure was so strong that the usual practice followed in the case of private Bills, *i.e.*, a second reading and consideration by a Committee, was abandoned, and the matter was put to the vote. The motion for a second reading was rejected by a large majority.

Glasgow.—Relief of Traffic Congestion.—In a report recently presented to the Corporation, the general manager of the tramway undertaking (Mr. James Dalrymple) considers several proposals for relieving the present traffic congestion of the city. Overhead systems, such as those employed in the United States, are dismissed as too noisy and unsightly. The underground system is considered in a favourable light, but the employment of motor omnibuses on routes already served by tramcars is not thought suitable. The construction of an additional bridge and the carrying out of tramway schemes already sanctioned are recommended.

Keighley.—Increased Receipts.—A report of the general manager for the year ended March 31st last shows that the number of passengers carried on the tramways increased by 262,459, and the receipts by £1,232. On the trackless system the receipts rose by £1,027, and the number of passengers by 50,097.

Leeds.—Extension of Time.—The Ministry of Transport has extended the time of the Leeds Corporation Act, 1914, for the completion of the tramway, until August, 1922.

London.—Automatic Ticket Machines.—The Underground Co. has installed, as an experiment, an automatic ticket-delivering machine at the Leicester Square station. By means of this device, the issuing of tickets is expedited to a very large extent, and it is probable that the machine will be applied to other busy stations.

L.C.C. Tramways Deficit.—It is stated in a report presented to the London County Council by the Highways Committee that the approximate aggregate expenditure on the Council's tramways for the 12 months from April 1st, 1920, to March 31st, 1921, was £5,464,339, while the aggregate traffic receipts during the same period were only £4,794,567, leaving an approximate deficit during the 12 months of £669,682. After taking into account receipts from other sources, such as advertisements, rents of lines worked under agreements, &c., it is anticipated that this deficit will be reduced to about £540,484.—*Morning Post.*

Track Renewals.—A portion of the Edgware Road tramway track at Hendon is to be reconstructed at a cost of £137,000.—*Evening News.*

Northumberland.—Motor 'Buses.—The Tyneside Tramways and Tramroads Co. has applied to the Minister of Transport for consent to the running of omnibuses in the County of Northumberland in extension of or in connection with the company's tramways.

Newcastle-on-Tyne.—Motor 'Buses.—The Corporation has applied to the Minister of Transport for consent to the running of motor-omnibuses along certain routes outside the City and County of Newcastle-on-Tyne.

Sunderland.—Improvements Deferred.—On account of the industrial disquietude, the Town Council has deferred a scheme to widen and improve Ryhope Road between Langham Tower and Villette Road, at a cost of £52,500, to which the Government was to contribute £15,975 and the tramway undertaking over £12,000.

St. Helens.—Track Renewals.—The Tramways Committee has decided, with the approval of the Town Council, to carry out the work of relaying 2 miles of the St. Helens junction tramway track by contract or direct labour, and instructions have been given to the borough engineer to obtain alternative tenders for carrying out the work:—(*a*) By taking on a proportion of the unemployed men from the labour exchange in accordance with the conditions laid down by the Unemployment Grants Committee; (*b*) Without any restrictions as to taking on unemployed men.

TELEGRAPH AND TELEPHONE NOTES.

U.S.A.—Pocket Wireless Apparatus.—Every policeman in Chicago is to be equipped with wireless telephone apparatus so small and light that it can be carried concealed in the tunic, says *The Times*. By means of it the officer will be able to communicate direct with police stations, fire-patrol boats, and fire stations.

Cable Laying by Aeroplane.—A 6-mile stretch of land telegraph cable was laid and put into service in eight minutes by an aeroplane that came from its station 40 miles away in Sweden recently. Of the eight minutes, six were spent in flight and the other two in making connections. Great possibilities, both military and commercial, are seen by air service officers in this new enterprise. Equipment of planes for cable laying is simple and inexpensive. The cable is unreeled from the machine in flight with a flag marker at the end to guide signalmen on the ground to it. When over the point at the other end of the stretch of ground to be covered, the wire is cut from the reel and the free end weighted, marked, and dropped. The men below merely have to pick it up and connect it to begin talking with the forces at the other end.—*T. & T. Age*.

Holland.—New Telephone Cable.—It is hoped to lay, in the near future, a telephone cable between England and Holland.

Wireless Telephony.—An arrangement was recently come to between the Nederlandsche Seintoestellen Fabriek, a Dutch wireless company in which the Marconi Co. has a considerable interest, by which, over an experimental period of three months, Stock Exchange prices were reported by wireless telephony to a large number of banks throughout Holland. The experiment ended a few days ago, after having proved completely successful. The British and Dutch Governments have granted a licence to the Marconi Co. to experiment with wireless telephony between the two countries. A station for the purpose has been erected in this country, but the station on the Dutch side is not yet constructed. The Marconi Co. is also constructing experimental wireless telephone stations to operate between London and Birmingham, and believes that communication can be rendered free from interruption and "tapping," and that the ordinary apparatus used by every telephone subscriber will be able to be utilised to communicate with the local wireless telephone stations, and that connection for the long-distance wireless telephone messages may be thus obtained.—*The Times*.

Jersey.—Wireless Communication. — Strong representations, says the *Daily Telegraph*, are being made to the proper quarter with a view to a wireless station being established in Jersey. The station has been dismantled, and at present the island is cut off from the outer world when the General Post Office is closed.

Press Cable Rates to Canada.—The *Empire Press Union Circular* announces that the Newspaper Proprietors' Association and the Newspaper Society have been invited to participate with the Union in a deputation to Mr. Winston Churchill on the subject of Press cable rates to Canada. According to *The Times*, at the present time a great deal of the cabled news from England reaches the Canadian Press *via* the United States, owing to the low charges of American news syndicates. The deputation will seek to obtain as a remedy for the present situation lower Press rates and a better service between England and Canada.

The Telephone Service.—During the Bedford by-election activity in the rural area of the constituency, the villagers seized the opportunity of the Postmaster-General's visit to press upon him the necessity for extending telephone facilities in rural areas by making village telegraph offices and telephone call offices as well. Mr. Kellaway said that he had no idea that the desire for these facilities was so keen. He undertook, if he was returned, to give immediate attention to the subject of village telephones, and if it could be shown to be economically possible, he would introduce them. Mr. Kellaway declared that the Post Office must be made self-supporting.

Mr. Pike Pease, Assistant Postmaster-General, in answer to a question in Parliament, said, on Tuesday, that satisfactory speech was obtained with Berlin (over 800 miles) before the war in the course of experiments. The most distant point with which communication was now obtainable was Marseilles (720 miles). Regular connection could be obtained by London telephone subscribers with Paris and Brussels, and when sufficient land-lines were available in France a similar service would be available with Switzerland.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Argentina.—June 18th. The Department of Overseas Trade has been informed by telegram that the Department of Sanitary Works is calling for tenders for the supply and erection of electric-power batteries and lighting plant at Mar del Plata. Local representation is essential. When a copy of the specification is received by the Department of Overseas Trade it will be made available for consultation.

Australia.—Melbourne.—Postmaster-General's Department. May 31st. Telephone switchboards (Schedule No. 1,670).*

Postmaster-General's Department, May 31st. Supply and delivery to several States of manual telegraph transmitting devices (Schedule No. 1,680). (April 8th.)

May 31st. P.M.G. 29,500 porous cells, No. 1 size to specification (Schedule No. 1,685); 20½ tons ammonium chloride (Schedule No. 1,683).*

May 31st. Victorian Electricity Commissioners. Morwell power scheme: Street poles (Specification No. 47); copper cable (Specification No. 66). (April 15th.)

June 15th. Victorian Government Railways. 50 oil-immersed single-phase track and signal transformers for power signalling (Contract No. 33,901). Tenders to Victorian Railway Commissioners, Spencer Street, Melbourne, accompanied by a preliminary deposit of ½ per cent. of the total amount of the offer. Local representation is essential. Specification may be consulted by British firms at the Department of Overseas Trade in London (Room 59).

June 22nd. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery charging equipment.—*Reuter's Trade Service* (Melbourne).

August 10th. 250 core-type impedance bonds for power signalling, with a capacity of 1,000 amperes per rail; also 50 miles of solid insulated copper wire, No. 14, Brown & Sharpe gauge, and 50 miles of solid insulated copper wire, 16 standard gauge.

August 17th. 3,000 sets of renewals for caustic soda primary cells.—*Reuter's Trade Service* (Melbourne).

August 30th. Board of Works. Four electrical centrifugal pumps, each with a capacity of twelve milion gallons daily.—*Reuter's Trade Service* (Melbourne).

Perth.—May 25th. Postmaster-General's Department. Ironwork, as per Schedule 704. (See this issue.)

Belgium. — May 27th. The Service d'Etudes et de Controle des Applications de l'Electricité, 52, Boulevard du Regent, Brussels. For the supply and installation of ten electrically-operated capstans in connection with the locks on the Upper Scheldt.

April 28th. Municipal authorities of Saint-Gilles-lez-Bruxelles. Cooling plant for the electricity generating station. Specification from the Service de l'Electricité, R 40, Rue de Bethléem, Saint-Gilles, near Brussels. Tenders to the College Communale.

Brussels.—May 11th. Belgian Post and Telegraph authorities at La Salle de la Madeleine, Brussels. Supply of a quantity of telegraphic and telephonic apparatus, including 600 Morse manipulators and 250 milli-amperemeters.

Buenos Aires.—June 3rd. Board of Sanitary Works. Supply and erection of the plant and accessories for a new generating station, previous tenders having been called for in 1919 and 1920. The plant comprises three four-cycle Diesel engines of 375-h.p., and adapted to run on crude petroleum from Comodoro Rivadavia, and three three-phase alternators, each of 250-kW, 2,200 volts between phases, 50 cycles and a power factor of '8.*

Farnworth.—April 28th. Electric wiring of 20 houses, for Urban District Council. Specifications, &c., from Mr. W. J. Lomax, 11, Fold Street, Bolton. Deposit, £2 2s. (returnable).

Fiji Islands.—The municipality of Suva invites tenders, closing June 30th, for the supply and erection of a 200-kW, 480/520-V, three-wire, d.c. generator, directly coupled to a 300-h.p. vertical Diesel oil engine, together with accessories for generator and panel.—*Reuter's Trade Service* (Melbourne).

Ipswich.—Electricity Supply Department. One 500-kW rotary converter or motor converter. (April 15th.)

Jugo-Slavia.—May 1st. The Serb, Croat, and Slovene Ministry of Public Works. Erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semlin, &c.*

Commercial Secretary to H.M. Legation at Belgrade has received an inquiry from a local contractor in regard to plant, &c., required for the electric lighting of a town in Serbia. The inquirer wants offers from United Kingdom firms for two

40-kW dynamos and 50 km. of overhead cable, &c., for the supply of current to about 1,200 houses. The Serb-Croat-Slovene State is one of the countries to which the Export Credit Scheme applies. The name and address of the inquirer may be obtained on application to the Department of Overseas Trade in London.

Kearsley.—April 23rd. Electric wiring of 20 houses, for Urban District Council. Specification, &c., from Mr. W. J. Lomax, 11, Fold Street, Bolton. Deposit, £2 2s. (returnable).

London.—Fulham.—May 4th. Electricity Department. Two Green economisers or other approved make of 400 and 440-tube capacity respectively. (See this issue.)

Manchester.—May 2nd. Electricity Committee. Three steam turbine-driven boiler feed pumps. (April 15th.)

New Zealand.—June 28th. Public Works Department. Ten s.p. oil-filled transformers for the conversion of three-phase current at 50 cycles, the voltage ratio being 50,000/11,000, for Waikato power scheme. Tenders must be accompanied by a deposit of £100, and sent to the Secretary, Public Works, Tenders Board, Government Buildings, Wellington. Specifications may be seen at the Department of Overseas Trade, 35, Old Queen Street (Room 59), Westminster, S.W.1.

June 28th. Supply and delivery at Lyttelton of two 50-kVA, two 100-kVA and two 200-kVA condensers in connection with the Lake Coleridge electric power supply (Section 116). Tenders to Secretary, Public Works Tender Board, Government Buildings, Wellington. Deposit, £50. Specifications, &c., may be seen at the Department of Overseas Trade (Room 59) in London.

South Africa.—Pretoria.—May 10th. Municipality. Switchgear. Tenders, marked "Electric Light and Power Department, 1920 Extensions, Contract No. 5," to Deputy Town Clerk, Municipal Offices, Pretoria. Deposit, five guineas. Further particulars may be obtained from the general manager of the Electric Light and Power Department, or from the consulting engineer, Mr. G. M. Clark, 40-42, Meischkel's Buildings, Johannesburg.

St. Anne's-on-Sea. — Electricity Department. One natural draught cooling tower. (April 15th.)

St. Helens.—May 1st. Electricity Department. One d.c., 3-wire, distributing switchboard, complete with supporting steelwork. (April 8th.)

Swinton.—April 30th. Electric wiring of 30 houses on Temple Lodge estate, Manchester Road, for Swinton and Pendlebury Urban District Council. Specifications from J. Knight, architect, Haworth's Buildings, 5, Cross Street, Manchester.

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Aberdare.—At last week's meeting of the District Council it was reported that three tenders had been received for service cable, one from a Danish firm for £151, one from a German house for £179, and another for £281 from an English manufacturer. One member moved that the Danish tender be accepted, and Mr. E. Stonelake, in seconding, said they should have no qualms of conscience in accepting the lowest tender owing to the "ring" among English manufacturers. Another member suggested putting off the work for a month in order to see whether a fall in prices occurred which would allow them to place the order with the English firm; but the Electricity Manager (Mr. Abraham) said a postponement of the order might interfere with the connections owing to a shortage of cable. An amendment for the postponement of the order was defeated, and the Council decided to accept the Danish tender.

Australia. — Melbourne. — The Victorian Railways Department has rejected the tenders received for the supply of an electrical furnace at the Newport workshops, owing to falling prices. The department will shortly again invite tenders, closing in September. The cost is now estimated at £50,000. Particulars can be obtained from the Agent-General.—*Reuter's Trade Service* (Melbourne).

Bradford.—At a meeting of the City Council, Alderman M. Conway moved the reference back to the Tramways Committee of a minute in respect of the placing of a contract with the Anglo-Belgian Improvements Corporation, Ltd., for a hundred steel tramway tires. Alderman E. Priestley (Chairman of the Tramways Committee) replied that the Belgian quotation was nearly 50 per cent. below that of any English tender, and the Committee had decided, upon reconsideration, to let the tender to the Belgian undertaking. Alderman Conway contended that this was a matter on which further information ought to be given, and fresh tenders ought to have been invited. The amendment referring the minute back was carried.

Edinburgh.—Corporation. Accepted :—

Electrical fittings for the Corporation houses at Abercorn, £2,406.—Cole & Co.

London. — L.C.C. Stores and Contracts Committee. Tenders accepted during the three months ended March 31st, 1921 :—

Electric traction lamps for the Tramways Department (Schedule No. 17a). 14 firms invited to tender.

British Union Lamp Works (estimated value, £366).
English Electric and Siemens Supplies, Ltd. (estimated value, £8,507).
Stella Lamp Co., Ltd. (estimated value, £432).

Highways Committee. L.p. cables in connection with the construction and reconstruction of the tramways from West India Docks to Mare Street :—

Western Electric Co., Ltd.	**£3,767**
W. T. Henley's Telegraph Works Co., Ltd.	3,888
Johnson & Phillips, Ltd.	3,920
Callender's Cable & Construction Co., Ltd.	3,9 8
Siemens Bros. & Co., Ltd.	3,947
British Insulated & Helsby Cables, Ltd.	3,975
Union Cable Co., Ltd.	4,011
W. T. Glover & Co., Ltd.	4,036

Hammersmith. — Borough Council. Electricity Committee. Recommended :—

Push-plate overhead coal conveyor, £1,073.—W. & D. Conveyor Engineering Co., Ltd.
Electric crane, £2,100.—New Conveyor Co., Ltd.
5,000 yd. 3-core e.h.p. cable, £4,458; 500 yd. 6-core do., £256.—Western Electric Co., Ltd.
2½-in. centrifugal oil pump, £50.—Gwynne's Engineering Co., Ltd.
24 new cells for the storage battery, £451; removing 91 cells to the new position, £180; 91 extra glass boxes for the existing cells, £153.—Premier Accumulator Co., Ltd.
Two auto-transformers in connection with the linking-up scheme, £650.—Hackbridge Electric Construction Co., Ltd.
Mechanical soot-blower, £210.—Diamond Blower Co., Ltd.
400 yd. single-way conduit in connection with the extension of the main from Church Wharf, Chiswick, to the Chiswick E.S. Corporation's generating station, £86.—Sankey & Co., Ltd.

Sunderland.—Corporation. Accepted :—

Pirelli-General Cable Works, Ltd.—Armoured low-pressure feeder cable, unarmoured low-pressure feeder cable, twin unarmoured low-pressure network cable.
General Electric Co.—Two low-pressure feeder panels.
British Insd. & Helsby Cables, Ltd.—Two-feeder pillars.
Doulton & Co., Ltd.—Stoneware ducts.
Ferranti, Ltd.—54 d.c. meters, 250 a.c. meters.
C. H. Johnson & Sons, Ltd.—Band conveyor.
Babcock & Wilcox.—Parts for coal conveyor.
A.E.G. Co.—Nozzle plate for turbine.

FORTHCOMING EVENTS.

Edinburgh Electrical Society.—Friday, April 22nd. At the Philosophical Institute. At 8 p.m. Open night.

Physical Society of London.—Friday, April 22nd. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

Royal Institution of Great Britain.—Friday, April 22nd. At Albemarle Street, W. At 9 p.m. Lecture on "Electro-Synthesis in Organic Chemistry," by Sir James Walker, F.R.S.

Thursday, April 28th. At Albemarle Street, W. At 3 p.m. Lecture on "Nationalisation and Bureaucracy," by Mr. H. S. Foxwell.

Technical Inspection Association.—Friday, April 22nd. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Lecture on "The Physical Properties of Clay," by Mr. A. S. E. Ackerman.

Electrical Power Engineers' Association.—Lectures on "The Work, Aims and Scope of Association," will be given at Sheffield (the Royal Victoria Station Hotel), on April 23rd, at 7 p.m.; at Middlesbrough (Literary and Philosophic Institute), on April 25th, at 7 p.m.; and on Saturday, May 7th, at Maidstone.

Electrical Trades Benevolent Institution.—Monday, April 25th. At the Offices of the Cable Makers' Association, Sardinia House, Sardinia Street, W.C.2. At 2.30 p.m. Annual general meeting.

Illuminating Engineering Society.—Tuesday, April 26th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 8 p.m. Discussion on "Ship-Lighting, in relation to Comfort, Safety and Efficiency." To be opened by Mr. W. J. Jones.

Institute of Physics.—Wednesday, April 27th.—At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Public inaugural meeting. Address by Sir J. J. Thomson, O.M.

Institution of Railway Signal Engineers (Incorp.).—Wednesday, April 27th. At the Midland Grand Hotel, St. Pancras. At 6 p.m. Paper on "Magnetic Storms: Their Effects upon Railway Signal and Telegraph Apparatus," by Mr. W. J. Thorncwgood.

Manchester Wireless Society.—Wednesday, April 27th. At the Albion Hotel, Piccadilly. At 7.30 p.m. Ordinary general meeting.

Institution of Electrical Engineers.—Thursday, April 28th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Discussion on "Tariffs." Papers on "Electricity Supply—Present Conditions and the Hopkinson Principles," by Mr. J. R. Blaikie; and on "Multi-part Tariffs for Domestic Electricity Supply," by Mr. J. W. Beauchamp.

Informal Meeting.—Monday, April 25th. At the Institute of Patent Agents, Staple Inn Buildings. At 7 p.m. Discussion on "Engineering in Russia." To be opened by Mr. C. L. Lipman.

Students' Section.—Friday, April 22nd. At Finsbury Technical College, Leonard Street, E.C. At 6.30 p.m. Paper on "Searchlights as used for Coast Defence," by Mr. R. C. Hawkins.

Friday, April 29th. At the City and Guilds Engineering College, South Kensington. At 6.30 p.m. Annual general meeting. Paper on "Radio-Telegraphic Transmitting Apparatus," by Mr. A. C. Warren.

Liverpool Sub-Centre. — Monday, April 25th. At the Liverpool University. At 7 p.m. Annual general meeting and smoking concert.

North-Eastern Centre.—Monday, April 25th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Ordinary meeting.

North-Midland Centre.—Tuesday, April 26th. At the Hotel Metropole, Leeds. At 7 p.m. Annual general meeting.

South-Midland Centre. — Wednesday, April 27th. At the University, Birmingham. At 7 p.m. Annual general meeting. Paper on "Magnetos for Ignition Purposes in Internal-Combustion Engines," by Mr. E. A. Watson.

Scottish Centre.—Friday, April 29th. At Dundee. Ordinary meeting.

Junior Institution of Engineers.—Friday, April 29th. At Caxton Hall, Westminster, S.W. At 8 p.m. Lecturette, "Rambling Remarks on Expert Evidence," by Mr. W. A. Tookey.

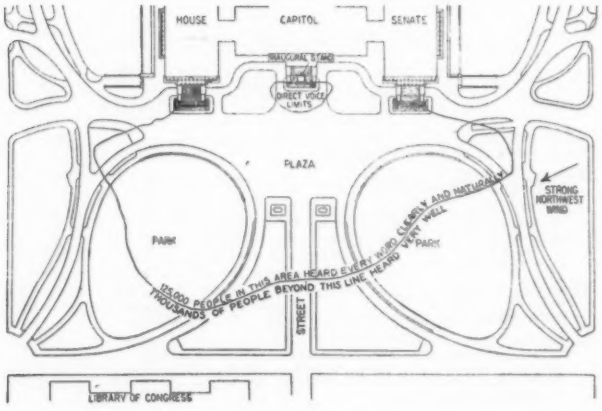
NOTES.

Patent Office Appointments.—The Civil Service Commissioners announce that an open competitive examination for not fewer than 20 situations as assistant examiner in the Patent Office, Department of the Board of Trade, will be held in London in July next, commencing on the 12th of that month. Limits of age: 20 and 25, with extension for service in H.M. Forces. Regulations and forms of application will be sent in response to requests by letter addressed to the Secretary, Civil Service Commission, Burlington Gardens, London, W. 1, on and after April 25th.

The Second Simplon Tunnel.—By the end of March, 10,369 metres on the southern, and 9,072 metres on the northern side of the second Simplon tunnel had been bored; this is 98·1 per cent. of the total length. It is now 10 years since it was decided to bore a second Simplon tunnel, and the work was undertaken by Switzerland in the following year. The first tunnel was begun in 1898, and opened for traffic in 1906.—*The Times.*

Radium in Bulk!—*The Times* states that President and Mrs. Harding will receive Mme. Curie in the White House on May 20th and present her with a gramme of radium value at $100,000 on behalf of American women.

An Audience of 250,000.—*The Transmitter*, which is the house organ of the Chesapeake and Potomac Telephone Co. and associated companies, recently gave a graphic description of the scenes at the Presidential installation at Washington on March 4th. By means of the Bell loud-speaking system a vast assembly of people, estimated at 250,000, was able to listen to the inaugural speech of Mr. Harding, and it is stated that fully 125,000 could hear every word distinctly. The great "Plaza" which the Capitol faces was crowded to its limits, the participants in the ceremonies being grouped upon a specially erected stand in the roof of which horns were fitted in concealed positions. The whole of the electrical equipment of the system was placed under the steps of the Capitol; transmitters on the stand picked up the tones of the speaker, and the vibrations set up were transmitted to the control-room, where



eight successive stages of vacuum tube amplifiers magnified the energy, and the amplified vibrations were sent out in voice form from the trumpets at the top of the stand. The adjustment of these horns to secure uniform distribution occupied a great deal of time, but the results given were eminently satisfactory. People at a distance of 1,200 ft. heard the speech distinctly, and it is said that those near the stand could distinguish no variance between the President's natural voice and the amplified tones. Some idea of the meaning of the achievement may be gathered from the accompanying plan.

The Chesapeake Co. was congratulated by the chairman of the Joint Congressional Inaugural Committee upon the excellent results obtained.

Guaranteed Wiring in the United States.—In accord with new regulations adopted by the Maryland State Board of Electrical Examiners and Supervisors, all master electricians in the State who install electrical work of any kind must give a bond of $1,000. This is to ensure absolute responsibility for defective wiring. Under the new provision, any person who discovers within a year after the completion of an installation that such wiring was defective can appeal to the Board for damages.—*Electrical World.*

Educational.—Faraday House Entrance Scholarships.—As a result of the Entrance Scholarship Examination, held at Faraday House on April 12th, 13th and 14th, the following awards have been made:—

To H. G. Spencer, Erith County School, the "Maxwell" Scholarship of 50 guineas per annum, tenable for one year in college and one year in works.

To E. F. Smith, Emanuel School, an exhibition of 30 guineas, tenable for one year in college and one year in works.

To E. W. M. Scott, Oundle School, an exhibition of 20 guineas, tenable for one year in college and one year in works.

To W. A. Bennett, Mundella Secondary School, an entrance prize of 20 guineas.

The "Motor Effect" in the Ajax-Wyatt Furnace.—Dr. E. F. Northrup, of Princetown University, discusses the nature and explanation of the above effect in the *Journal* of the Franklin Institute. He first develops a formula for calculating the mechanical forces which arise by the interaction of a triangular circuit carrying a current upon any short section of the circuit. Numerical results are tabulated, and the values of the forces are given in the form of a chart. Formulæ are next derived for calculating the internal pressure-forces in a thin strip of conductor, and numerical results are again tabulated, and a curve giving the pressure as a function of the distance from the axis of the strip is appended. The third section of the paper sets out the necessary assumptions which were made in the calculations, and the last section explains the meaning and exactly defines the motor-effect. It is shown also that such an effect actually exists, and assumes considerable importance, in the "Ajax-Wyatt furnace." A chart shows the magnitude of the forces which produce the motor-effect, and a new experiment is referred to which conclusively proves that the motor-effect not only exists, but may be manifested apart from, and independent of, any internal pressure-effect. The effect of the mutual attractions of current elements in producing fluid motion are generally considered, and the internal pressure-effect is defined. The important conclusion is reached that the Ajax-Wyatt furnace secures both the internal pressure-effect and the motor-effect in an advantageous way for obtaining practical results. It is further pointed out that the securing of these two effects at widely-separated sections of the conductor is a valuable and, as far the author knows, a novel result in furnace construction of the induction type.

Accidents.—On April 12th, John Hay, an electrician at the Corporation electricity works, Aberdeen, was working in a cable pit at the rear of a high pressure switchboard, when, owing to his coming into contact with a "live" part or to the fusing of a wire, he received severe burns on his face and arms. He was removed to the infirmary.

A sub-section attendant of the Sunderland Corporation, George Cowling, was attending to some plant at the Sunderland Shipbuilding Co.'s yard, when he received an electric shock which rendered him unconscious.

Grants Towards Agricultural Appliances.—The French *Journal Officiel* of April 1st contains a decree of the Ministry of Agriculture stating the conditions on which subsidies may be granted to French farmers for the purchase of electrically-operated agricultural machinery, &c. When made in France, 25 per cent. of the cost of such machinery will be granted; but if the articles are imported from abroad only 10 per cent. will be advanced.

Fatalities.—While playing at Bargoed, Glamorgan, on Tuesday evening last, a youth named Evan Jones was seriously injured in, it is alleged, attempting to slide along the overhead transmission wires carrying electricity to the Powell Duffryn Colliery, thereby receiving a shock at 10,000 volts. When the lad was picked up it was found that one of his legs up to the knee and some of his fingers had been burnt away. He died the same night in hospital.

Appointments Vacant.—Two cable jointers for the Eccles Corporation electricity works; mains assistant (£293) for the Doncaster Corporation electricity department; research physicist in the Admiralty Department of Scientific Research and Experiment (£250 + war bonus); junior charge engineer, for the Coventry Corporation Electricity Department. See our advertisement columns to-day.

The Engineers' Club for London.—Without the aid of Aladdin's lamp—or to be up to date, shall we say, "Alf's Button"—it is impossible to bring an engineers' club into existence in the twinking of an eye. Hence the eager supporters of the scheme must curb their impatience for a little while, and give the organisers a chance to lay the foundations well and truly, so that the superstructure may be perfect in its parts and honourable to the builder.

The Executive Committee is by no means idle; it has a big task in hand, but is hopeful of finding temporary accommodation, at any rate, which will enable the club to come into residence this summer, and the rules, &c., are being drafted in readiness for submission to a general meeting. Since the proposed conditions of membership were circulated, over 1,000 firm applications have been received, including many from engineers abroad and in the British Dominions. Those engineers who intend eventually to join, but have not yet communicated with the hon. secretary (Mr. Ed. L. Hill, 39, St. James's Street, S.W. 1), are invited to do so at once; the greater the number of prospective members, the easier will it be to secure suitable premises.

Electric Vehicle Charging and Garaging Facilities.—An alteration in the City of Birmingham Electric Supply Department's rates for electric vehicle charging and garaging has been made and will take effect as from July 1st next:—In the Department's Depôts, subject to accommodation being available from time to time, garaging charges per vehicle will be as follows:—(*a*) 4s. per day; 20s. per week (six or seven days); 2s. per visit during day time for boosting purposes. (*b*) The rate for electricity will be 2d. per unit metered into the consumers' batteries. Consumers are reminded that vehicles are charged and garaged by the Department at owners' risk, and should be protected by insurance or otherwise, accordingly. For vehicles charged on consumers' premises, provided arrangements are made for separately metered circuits, the rate of charge will be 1½d. per unit metered on the supply mains side of consumers' apparatus.

The Use of Electricity in the United States.—A recent issue of *Power* gives some statistics from a report of the Geological Survey, which give some idea of the magnitude of the electricity supply industry in the United States. The figures are gathered from repors for the year 1920 of about 3,000 undertakings with a capacity of 100 kW or more.

The mean daily output of electricity for each month of the year ranged from 115,600,000 kWh for May to 124,700,000 for January, and for the year, 120,000,000. The proportion of this output resulting from water power varied from 33 per cent. in January to 42 per cent. in May. The year's total production was 43,900,000,000 kWh, of which 37½ per cent. was from water power; this ratio was practically the same in 1919.

The year's production of 43,900,000,000 kWh was 12·9 per cent. greater than that of 1919. The amounts of coal, fuel oil, and gas used to produce this electricity, however, increased 6·0, 18·4, and 13·6 per cent. respectively. This disproportionate increase in the consumption of fuel oil has a significant bearing on the question of the diminishing oil supply.

If the fuel oil, gas, and wood consumed in generating electricity were converted to equivalent coal, the coal consumption in 1919 would have been 38,500,000 tons, and in 1920 it would have been 41,200,000 tons—an increase of 7 per cent. The increase in the production of electricity for the same period was 12.9 for cent., which indicated a gain of efficiency in the consumption of fuels during 1920. On the basis of equivalent coal coal consumed for each of the two years, a kilowatt-hour of electricity was produced in public-utility plants in 1919 by 3·17 lb. of coal and in 1920 by 3·01 lb. These figures show a gain in economy of fuel consumption of 5 per cent., or a saving of about 2,000,000 tons of coal in the production of electricity in 1920 as compared with the rate of fuel consumption per kilowatt-hour in 1919.

Slate and Profiteering Act.—On April 11th, his Honour Judge Snagge, at the County of London Appeal Tribunal, heard the appeal of J. J. Greenwool (trading as John Williams & Co.), slate manufacturers, against a decision of the Bermondsey Profiteering Committee. The original case was brought against appellant by the National Telewriter Co., Ltd., who complained that they had been charged £10 6s. 3d. for 25 pieces of slate. The Profiteering Committee held that the reasonable price of the material was £2 16s. 3d., ordered a refund of the balance, and decided to prosecute the present appellant. Counsel for appellant said that the slate did not come under the heading "Building Materials" included in the Profiteering Act, as the material was used for electrical purposes. His Honour Judge Snagge agreed with this presentation of the case and allowed the appeal.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Informal Meeting.—Mr. W. E. Bradshaw was in the chair, on April 11th, during the discussion which was opened by Mr. F. Creedy, on "Some Characteristics and Applications of Multi-speed a.c. Motors." Mr. Creedy confined himself to the pole-changing type as developed by himself. This he claimed, under certain conditions, was the best method obtainable to date. For motors having a gradual speed variation, the commutator motor was the only possible type, and there might be a field for these in sizes up to 50 h.p.; in larger sizes, however, they hardly could be considered commercially practicable. He explained in detail the windings and switchings which gave the variable speeds, and urged that speed ratios of the required duty should be carefully studied when the type of motor was under consideration. Broadly speaking, the relative advantages of the cascade and pole-changing methods depended mainly on the ratio of speeds; some ratios were very complicated for cascade and easy for pole-changing. He concluded with acknowledgments to Messrs. F. & A. Parkinson, Ltd., and the Electrical Construction Co., Ltd., his licensees, for diagrams and data.

Mr. W. E. M. Ayres, who spoke next, stated that the call for variable-speed motors was often mistaken, and it could be met by simple arrangements of ordinary motors. He mentioned a 100-h.p. colliery fan with two speeds which it had proved more economical to re-wind as a single-speed machine, and run with resistances during the week-ends. He also criticised the Scherbius and Kramer methods on account of the complicated switchgear.

Mr. J. K. Smith spoke from actual experience of the Creedy pole-changing machine, which he had found satisfactory in connection with heavy machine-tool drives previously operated by d.c. motors. He pointed out that in view of the substitution of polyphase for d.c. supply, some form of variable a.c. motor was essential to replace the d.c. variable speed one.

Mr. W. L. Wreford and Mr. G. J. D. Scott spoke of very definite demands for variable-speed motors, notably on printing machines and air compressors. Mr. B. P. Walker also referred to their application to express lift service. Mr. W. E. Bradshaw and Mr. H. Cooch also spoke.

Mr. Creedy, in concluding a most interesting discussion, reminded the meeting that the pole-changing a.c. motors under review had the same torque at all speeds, while d.c. motors, through weakening the field, needed to be built for the maximum horse-power at the lowest speed required, resulting in a larger machine than was the case with the a.c. constant torque multi-speed motor. With regard to the question of power factor, he pointed out that although the power factor suffered at low speeds, the actual wattless current taken from the line was constant at all speeds. The power-factor reductions, of course, were due to the watt component being reduced at the lighter load corresponding to reduced speed.

Liverpool Sub Centre of the North-Western Centre.—The nominees for election as officers and committee for the 1921-22 session are as follows:—Chairman, Mr. G. H. Nisbett; vice-chairmen, Messrs. B. Welbourn and E. M. Hollingsworth; hon. secretary, Mr. Oscar C. Waygood; committee, Messrs. A. J. Eames, J. Hamilton, A. E. Malpas, P. Priestley, and P. J. Robinson. Since the number of nominations corresponds to the vacancies, there will be no necessity for a ballot.

East Midland Sub-Centre.—On April 12th, at the Loughborough College, Mr. H. Cotton, of the Nottingham University College, delivered a lecture on "Electric Drives for Rolling Mills and Colliery Winders." The speaker dwelt with emphasis on the efficiency and convenience of the electric motor as compared with the steam engine, and gave interesting examples of the application of the electric drive to collieries and steel works.

Scottish Centre.—At a meeting of this Centre, held in Glasgow, Mr. E. T. Goslin presiding, Mr. C. W. Marshall, of the Glasgow Corporation Electricity Department, read a paper on "Continuity of Supply."

The following office-bearers were elected for the year:—Chairman, Mr. E. T. Goslin; vice-chairmen, Mr. A. S. Hampton and Mr. R. B. Mitchell; hon. secretary, Mr. Joseph Taylor; assistant hon. secretary, Mr. W. F. Mitchell; and chairman of the Students' Section, Mr. Alex. Lindsay.

On June 8th a paper on "The Hydro-electric Resources of the Scottish Highlands" will be read by Prof. Magnus Maclean; and on June 9th and 10th the members will take part in an excursion [forming part of the Institution's Summer Meeting] to the West Highlands, going by steamer to Fort William, and calling at the Kinlochleven works of the British Aluminium Co.

Warrington Electrical Society.—Addressing the members of the Society on the "Wonders of Electricity," Mr. J. B. Robertson said that they stood at the threshold of a new expansion, for the power stations were being linked together, and new stations were being erected with every refinement of economy in the generation of power in large quantities. Systems of electrical mains were being spread wider, both underground and overhead, so that in time the most remote districts would enjoy the service which was now the privilege of towns. As that movement progressed, the coal resources of the country would be utilised more and more in a limited number of efficient centres.

Physical Society of London.—At a meeting of the Society to be held to-day (Friday) at the Imperial College of Science, the following papers will be read:—"The Effect of Viscosity on Orifice Flows," by Mr. W. N. Bond, M.Sc.; "The Viscosity of Water at Low Rates of Shear," by A. Griffiths, D.Sc., and Constance H. Griffiths, M.Sc.; and "A Method of Measuring Frequencies," by B. S. Smith and G. F. Partridge, B.Sc.

At the meeting held on April 8th a paper, entitled "A New Registering Microphotometer," was read by Dr. W. J. H. Moll, of the University of Utrecht. The device employs a diminished image of a slit, on which the filament of a half-watt lamp is focused, projected by means of a microscope objective on the photographic plate or other object of which the absorption is to be measured. A second similar objective focuses an imagine of the slit, magnified up to its original size, on a second slit behind which is mounted a sensitive thermopile of the author's own design connected to an improved D'Arsonval galvanometer. By suitable gearing to an electromotor the photographic plate is given a slow motion at right angles to the beam of light, and at the same time a drum of photographic paper, on which the spot from the galvanometer is focused, is caused to rotate at a suitable rate. A record is thus obtained of the density of the plate at different parts encountered by the beam of light. The arrangement is dead beat and so quick in response that intensity curves of close spectrum lines, Zeeman triplets, &c., are accurately recorded.

A new method of using the quadrant electrometer for the measurement of electrical power was described by Mr. Hubert Parry. This involved the use of a potential-divider across the supply circuit, and a standard non-inductive resistance in series with the load. An ammeter and a voltmeter were employed to measure the supply voltage and the load current. An example of its application to determine the power-factor of a condenser was quoted.

Electrical Trades Benevolent Institution.—The annual general meeting of the Institution will be held at the offices of the Cable Makers' Association on Monday, April 25th, at 2.30 p.m., to receive the Report of the Committee, and to pass the accounts for the year 1920; to elect members of the Committee of Management and Auditors, and to consider alterations of rules.

Glasgow and District Radio Club.—At the meeting held on March 30th Mr. T. Senior lectured on "Aerials." Mr. Senior was well qualified to speak on this subject, having had about 10 years' practical experience in the erection and fitting out of wireless telegraph stations. The various types of aerials in general use were illustrated by blackboard diagrams, and the advantages and disadvantages of each were emphasised. The different kinds of wire which could be used, ohmic resistance, skin effect of high-frequency currents, the necessity of good joints for efficiency were dealt with in turn, and fully explained. The most effective methods of insulation, the necessity for preventing swaying of the aerial wires, and the vexed problem of whether the free ends should be joined or left open, were also discussed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. F. Golding, chief electrical engineer and director of radio services in the Commonwealth of Australia Postal Department, has been appointed by the Commonwealth Postmaster-General as a commissioner to visit the United States, Canada, Britain, and the Continent, to inquire into various matters relating to telegraphy (including wireless) and telephony.—*Sydney Morning Herald.*

Senator Marconi has left England for Italy, with the object, it is reported, of carrying out further wireless experiments on board his steam yacht *Elettra*.

Mr. E. A. Edwards, A.M.I.E.E., of the Westinghouse Electric International Co., who is a captain in the Royal Corps of Signals (T.A.), has been appointed to command the 54th (East Anglian) Divisional Signals Defence Corps, with the rank of lieutenant-colonel.

The Times **states that Sir Gerald Chadwyck-Healey has been adopted as prospective Unionist candidate for the Newbury Division at the next General Election.**

Mr. J. J. Smith, for 21 years borough electrical engineer at Stockton-on-Tees, has resigned owing to ill-health.

Mr. H. E. Ellis, managing director of the City Electrical Co., of London, is leaving England on April 29th, on a tour of his company's agents in North and South America, Canada, Australia, New Zealand, India, and South Africa. He is willing to place his opinion formed at any of these overseas markets at the disposal of others who may get into touch with him.

Mr. J. W. Meares, M.Inst.C.E., Electrical Adviser to the Government of India, has been appointed Chief Engineer, Hydro-electric Survey of India, in succession to Mr. F. E. Bull, retired.

On Saturday last the marriage took place at Loughborough of Mr. F. S. Grogan, M.I.E.E., A.M.Inst.C.E., manager of the Arora Co., and Miss C. K. Norrington, who is already known to several electrical friends.

The professional practice of the late Mr. H. B. Ransom, M.Inst.C.E., 3, Victoria Street, S.W.1, has been transferred to Messrs. Dolby & Williamson, consulting engineers, 8, Princes Street, Westminster, S.W.1, to whom all correspondence should be addressed.

NEW COMPANIES REGISTERED.

Donald-Bean Insulators & Engineers, Ltd. (11,689).—Private company. Registered in Edinburgh April 11th. Capital, £15,000 in £1 shares (3,000 preference). To carry on the business of insulators, mechanical, electrical, and constructional engineers, ship and boat builders, ship repairers, and outfitters, &c. The first directors are: W. M. Donald, 53, Bothwell Street, Glasgow; A. Bean, 1, Shandon Street, Govan, Glasgow; H. London, 1, Lynedoch Terrace, Glasgow. Registered office: 11, Great Wellington Street, Glasgow.

Victor Electrics, Ltd. (174,199).—Private company. Registered April 13th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers of, dealers in and agents for, cars, carts, vans, bicycles, tricycles, conveyances, and carriages of all kinds, whether moved by mechanical, electrical, or other power; boats, launches, and yachts, &c. The first directors are: H. N. Outram, 5, Rectory Road, Southport; E. Outram, 76, Grange Road, Southport; H. Outram, 18, Balfour Road, Southport; A. Wilson, 7, Cumberland Road, Southport; W. Maitland, 7, Cypress Road, Southport; I. H. Lavery, 7, Grange Road, Southport; V. Barmas, 14, Bright Street, Southport. Qualification, 100 shares. Secretary: W. Ball. Registered office: Westminster Buildings, Lord Street, Southport.

Power Production Co., Ltd. (5,084).—Private company. Registered in Dublin December 10th. Capital, £1,000 in £1 shares. To carry on the business of designing, constructing, buying, selling, controlling, operating, and owning power plants of all kinds, &c. The subscribers (each with one share) are: D. J. Reilly, Trim, Co. Meath, solicitor; F. W. Forrest, Trim, Co. Meath, solicitor. The first directors are: J. Dornan and T. G. Price. Secretary: T. G. Price. Registered office: Commercial Buildings, Dame Street, Dublin.

British Sangamo Co., Ltd. (174,133).—Private company. Registered April 9th. Capital, £10,000 in £1 shares. To carry on the business of mechanical, electrical, and general engineers, manufacturers, suppliers and fitters of and dealers in apparatus, machinery, appliances, &c. The subscribers (each with one share) are: J. Brown, Springfield, Illinois, U.S.A., banker; R. C. Lanshier, Illinois, U.S.A., electrical manufacturer; S. B. Rogers, Great Eastern Hotel, E.C.3, electrical manufacturer. The first directors are not named. Solicitor: L. W. Croft, 2, Bond Court, Walbrook, E.C.

Greenlaw Electrical Supply Co., Ltd. (11,686).—Private company. Registered in Edinburgh April 7th. Capital, £4,000 in £1 shares (1,000 6 per cent. non-cumulative shares). To supply electricity in Greenlaw, Berwickshire, and district. The first directors are: J. Clapham, High Street, Greenlaw; J. S. Macgregor, High Street, Greenlaw; T. Clapham, High Street, Greenlaw; Sir John H. Campbell of Marchmont, Bart., Greenlawdean, Greenlaw; R. T. Kerr, Greenlaw Mill, Greenlaw; Dr. J. Marr, Ivy Lodge, Greenlaw; W. Middlemiss, Marchmont Road, Greenlaw. Secretary: A. Miller. Registered office: The Square, Greenlaw, Berwickshire.

Chisholm Bros., Ltd. (11,681).—Private company. Registered in Edinburgh April 6th. Capital, £1,200 in £1 shares. To take over the business of iron, coal, and steel merchants, and general exporters carried on at 190, West George Street, Glasgow, and to carry on the business of electrical, motor, and mechanical engineers, colliery furnishers, &c. The first directors are: J. Chisholm, 33, Calderwood Road, Rutherglen, clerk; G. G. Chisholm, 8, Clincerthill Road, Rutherglen, electrical engineer; J. Chisholm, 86, Stoneclaw Road, Rutherglen, merchant. Registered office: 190, West George Street, Glasgow.

Oldham Electrical Contractors, Ltd. (174,140).—Private company. Registered April 9th. Capital, £1,000 in £1 shares. To take over the business of electrical engineers and contractors carried on by J. E. MacNamara and A. Atkinson at Oldham as the "Oldham Electrical Repair Co." The subscribers (each with one share) are: F. Lord, 74, Beever Street, Oldham, builder and contractor; J. E. MacNamara, 46, Barker Street, Oldham, electrical engineer; A. Atkinson, 13, Mount Street, Chorlton-on-Medlock, Manchester, electrical engineer. F. Lord is the first director, and may retain office while holding £100 shares. Registered office: 46, Barker Street, Oldham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

C.E.C., Ltd.—Debenture dated April 4th, 1921, to secure £12,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: H. E. Ellis, 38, Fairholt Road, Stoke Newington, N.

Pinkney & Forster, Ltd.—Two mortgages dated March 30th and 31st, 1921, to secure £7,000 and £1,500 respectively, charged on 5 and 7, Saville Row, Newcastle-on-Tyne. Holder: Mrs. E. Stewart, 1, Granville Road, Newcastle-on-Tyne.

Cray Installations, Ltd.—Particulars of £8,000 debentures authorised March 17th, 1921, whole amount issued, charged on company's property, present and future, including uncalled capital.

John Tinsley, Ltd.—Satisfaction to the extent of £200 on January 31st, 1921, of debentures dated June 5th, 1912, securing £500.

Muirhead & Co., Ltd.—Satisfaction in full on April 1st, 1921, of debentures dated November 16th, 1904, securing £5,500.

Adams Bros. (Longton), Ltd.—Debenture dated March 21st, 1921, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: A. P. Ford, Basford, Stoke-on-Trent.

Peerless Flash Lamp Co., Ltd.—Particulars of £18,000 debentures authorised March 23rd, 1921, present issue £12,000, charged on the company's undertaking and property, present and future, including uncalled capital.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—Trust deed dated March 24th, 1921, supplemental to trust deeds dated June 30th, 1909, November 10th, 1914, May 3rd, 1915, March 14th, 1918, to secure £1,104,508 4½ per cent. consolidated first mortgage debenture stock, in addition to £1,042,000 secured by previous deeds. Property charged: Electrical undertakings of the company, freehold premises known as "Carville" and Neptune Bank, leasehold premises at Dunston, and company's other assets, present and future, except uncalled capital. Trustees: Whitehall Trust, Ltd., 2, St. Helen's Place, E.C.

Telegraph Manufacturing Co. (Colonial), Ltd. (71,854).—Return dated March 22nd, 1921. Capital, £2,000 in £1 shares. All shares taken up. £2,000 paid. Mortgages and charges: Nil.

Yorkshire (West Riding) Electric Tramways Co., Ltd. (84,167).—Return dated February 17th, 1921. Capital, £600,000 in £5 shares (70,000 preference and 50,000 ordinary), 46,261 preference and 40,977 ordinary shares taken up, £436,190 considered as paid. Mortgages and charges: £272,373.

CITY NOTES.

Cuba Submarine Telegraph Co., Ltd.

The report for 1920 shows that the receipts were £81,542 and the expenses £34,284. After providing £7,063 for income tax and adding £17,611 for difference in exchange and £21,150 brought forward, the total available is £78,957. Out of this £15,000 has been added to general reserve, £17,611 to reserve against loss on investments, and £2,500 to the pension fund. Interim dividends were paid in October at the rate of 10 per cent. per annum, less income tax, on the preference shares, and at the rate of 5 per cent. per annum, free of tax, on the ordinary shares, and the directors recommend final dividends at the same rates, and a bonus of 4s. per share on the ordinary shares, free of tax, leaving £26,646 to be carried forward, subject to E.P.D. Several sections of the cables underwent repairs during the year, while an attempt to repair the Cienfuegos-Santiago 1905 cable was unsuccessful, but it is hoped to restore this cable to working order after laying a new section from Cape Cruz to Santiago which is now being manufactured, and will be laid in the course of the next few months. The total cost of the work on the cables during the year was £24,542, and it was charged to reserve.

English Electric Co., Ltd.

In their report for the year ended December, 1920, the directors state that, after writing down stocks on a conservative basis to correspond with present day values, the balance to the credit of profit and loss account, including £45,302 brough forward, is £312,238. Deducting debenture interest and trustees' fees, £54,275; interest and discount, £84,608; dividend at the rate of 6 per cent. per annum on the preference shares, £41,914, leaves £131,441. A dividend on the ordinary shares at the rate of 8 per cent. per annum, less tax, will absorb £85,204, leaving £46,236 to carry forward. Certain dividends receivable from subsidiary companies (including the realised profit on the sale of certain assets) have been, in part, applied in writing off the entire expenses of, and discount on, the recent note issue, as well as reserving for the whole of the premium due on repayment, and in adding a further £25,000 to the capital reserve account. In view of the uncertainties of the present day position of trade throughout the world, the directors have considered it prudent to utilise these resources in the manner indicated, which is in close accord with their policy of last year. In order to replace expenditure incurred in the purchase of the Stafford Works, and stocks, and for other purposes, the company issued in November last £1,250,000 8 per cent. six year secured notes at 98 per cent. repayable at January 1st, 1927, at 103 per cent. Ten per

cent. of the proceeds of this issue was received prior to December 31st, 1920, and included in the accounts for 1920. The balance of £1,100,000 has been received since that date, and will appear in next year's balance sheet. Further progress in completing the amalgamation of the various undertakings controlled by the company was made during the past year. The properties of the Coventry Ordnance Works, Ltd., and Willans & Robinson, Ltd., have been leased to the company, and arrangements are now in progress for winding up the Phœnix Dynamo Manufacturing Co., Ltd., and the United Electric Car Co., Ltd. The directors are confident that this consolidation will facilitate control, and result in effecting greater economy in administration. The engineering trade was adversely affected by a series of labour troubles throughout the year, and more particularly by the moulders' strike, which, though it ended in January, handicapped output for a considerable period thereafter. The directors sincerely regret the loss of their colleague, Mr. Walter Rutherford, who since the close of the year has retired from the board and the management of the company. During the year under review, Mr. Robert Grant, jun., joined the board. Annual meeting: April 27th.

Eastern Telegraph Co., Ltd.—The directors will convene the annual meeting as soon as the full accounts can be submitted. A final dividend for the year 1920, of 2½ per cent., free of income tax, on the ordinary stock is to be paid, making the total for the year 10 per cent., free of tax, the same rate as was paid for the previous year. The usual distribution at the rate of 3½ per cent. per annum, less income tax, on the preference stock for the first quarter of 1921 is also being made.

Norwegian Marconi Co.—The A.S. Norsk Marconi Kompani has declared a dividend at the rate of 5 per cent. for 1920, making, with the interim distribution, a total of 15 per cent. for the year. The company was formed two years ago to acquire licences for the utilisation of Marconi patents for Norway and Norwegian ships, and the shareholders are shipowners and other shipping interests.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in, and the Committee has specially allowed dealings in:—

Electrical Apparatus Co.—30,423 10 per cent. "A" cumulative preference shares of £1 each, fully paid, Nos. 1 to 30,423.

And to allow the following to be officially quoted:—

Calcutta Electric Supply Corporation.—£500,000 5 per cent. first mortgage convertible debentures.

Victoria Falls & Transvaal Power Co.—£2,009,390 5 per cent. first mortgage debentures.

Yorkshire Electric Power Co.—80,306 ordinary shares of £10 each, fully paid, and £230,000 5½ per cent. redeemable debenture stock.

The Committee has ordered the undermentioned to be officially quoted:—

Hadfields.—78,118 ordinary shares of £1 each, fully paid (Nos. 1,600,001 to 1,663,118 and 1,866,667 to 1,881,666).

Johnson, Matthey & Co.—£250,000 8 per cent. seven-year notes (Nos. A1 to 2,100 (£10), B1 to 1,790 (£100), and C1 to 50 (£1,000). (Registered.)

Metropolitan Electric Supply Co.—£86,926 3½ per cent. mortgage debenture stock, redeemable.

Metropolitan-Vickers Electrical Co.—65,732 ordinary shares of £1 each, fully paid (Nos. 6,205,173 to 6,270,904).

Stewarts & Lloyds.—847,430 deferred shares of £1 each, fully paid (Nos. 1,782,501 to 2,629,930).

City Electric Light Co., Ltd. (Brisbane).—Credit balance for year ended January, 1921, £57,997, plus balance brought forward, making the total £58,427. An interim dividend was paid last September amounting with dividend duty to £25,829, and further dividends of 3 per cent. on the 6 per cent. preference shares, 3½ per cent. on the 7 per cent. preference, and 5 per cent. on the ordinary shares were recommended to the meeting in March. The payment of these dividends, together with the dividend duty and an allowance for Federal tax, absorbed £32,405, leaving £193 to be carried forward.

Indo-European Telegraph Co., Ltd.—The directors recommend a final dividend for 1920 of £1 2s. 6d. per share (making 7 per cent. for the year), free of tax; also a distribution out of equalisation of dividends fund of 15s. per share, free of tax, making a total of 10 per cent. for the year.

Electrical Utilities Corporation, Ltd.—A quarterly dividend of 1¼ per cent. on the preferred stock is announced for the quarter ended March 31st.

Kaministiquia Power Co.—Dividend at the rate of 8 per cent. per annum on the common stock for the quarter ending April 30th.

Bastian Meter Co., Ltd.—The directors report a net profit of £455 for the year, plus £589 brought forward. A dividend of 6 per cent. on the cumulative preference shares, and one of 6 per cent. on the ordinary shares are to be paid, leaving £328 to carry forward.

Eastern Extension, Australasia & China Telegraph Co., Ltd.—Final dividend on the old shares of 2½ per cent., free of tax, making a total distribution of 10 per cent., free of tax, for the year 1920, as in the previous year.

Switzerland.—La Société de la Fabrique d'Accumulateurs d'Oerlikon is declaring a dividend of 20 per cent. for last year.

Direct United States Cable Co., Ltd.—A final dividend of 4s. per share, less tax, making 4 per cent. for the year ended March 31st, is announced.

STOCKS AND SHARES.

Tuesday Evening.

Relieved from the apprehension of a general stoppage of work, the Stock Exchange markets were quick to respond to the altered conditions brought about by the refusal of the Railwaymen and Transport Workers to support the Miners' Federation. Prices improved in most departments, although it cannot be said that business increased to any noticeable extent. The position is still regarded as sufficiently unsettled for it to render buyers cautious of entering the markets except those for purely gilt-edged stocks. With the Budget to be introduced on Monday next, the domestic atmosphere is charged with financial, as well as political, uncertainty; while, abroad, the action of France with regard to the forthcoming May the First obligations of the Germans does not tend to reassure confidence.

The Home Railway market has naturally benefited from the blowing-over of the railway strike. Prices recovered in all sections of the market. The Undergrounds, which had fallen with the rest, although not to the same extent as the steam stocks, have hardened with their brothers, and Underground Electric Income Bonds are 3 better at 72¼. The rise of 5 points in Central London deferred non-assented stock to 22½ has been held. Apparently somebody wanted to buy a few hundred pounds, attracted by the wide difference between the quotation of this stock and that for the assented deferred, the latter standing about 42. As might have been expected, the buyer found nobody anxious to sell the lower-priced stock at the current nominal price, which was therefore advanced as already mentioned. Metropolitans slid back to 23½, to rally to 24½. Underground £10 shares gained ½ at £2. Guaranteed, debenture and preference stocks are all one to two points higher.

The English Electric dividend has had a strengthening effect upon the market in manufacturing shares. English Electrics advanced to 12s. 6d. Siemens rose to a guinea and the new shares to 20s. General Electrics are better at 23s. 3d., and the preference at 18s. 6d. British Aluminium at 16s. 3d. are ex dividend. Telegraph Constructions went back a little to 20.

The only changes in the list of electricity supply companies are a rise of ½ in Charing Cross 4½ per cent. preference, and a decline to 17s. in City of London 6 per cent. preference. The latter came about evidently as the result of shareholders trying to sell some of these in order to apply for the company's new 8 per cent. second preferences which are being offered at 20s. The subscription lists for the latter closed on Thursday and underwriters are very curious to see whether they will be left with any of the shares. The better conditions which became manifest in the markets on Tuesday evening and which produced substantial rises amongst gilt-edged securities, resulted from rumours that a settlement of the miners' strike was expected to take place practically at once. It had a pronounced effect upon many of the markets round the Stock Exchange.

At the meeting of the Stock Exchange proprietors to-day (Tuesday) it was announced that the managers had decided to spend £12,000 upon a new installation of electric light. Up to the present about £5,000 has been expended. When finished, the installation, according to the chairman of the meeting, will be up to date in every particular. Newcastle-on-Tyne 7 per cent. preference shares are better at 19s., and in this connection it may be pointed out that there is about £2,500 stock of the company's 4½ per cent. first mortgage debenture stock on offer at 71¾. Interest is payable in January and July. The stock is redeemable in 1939 at 100, or in 1922 at 105, unless by purchase. The yield, straight out, is 6¼ per cent. on the money, but allowing for redemption this is raised to 8½ per cent., and on the additional £2 there is, of course, no income tax to pay. The Central Electric 8 per cent. notes, over-subscribed by the public, are already quoted at a small premium.

The feature amongst Telegraphs and Telephones is a further jump to 2 7/16 in Marconi's. The preference have risen to 2⅜ and Marconi Marines to 1 7/16. Canadian Marconi's went up to 8s. 6d. Radio shares are still lagging a little behind the market in the parents. For the rise in Marconi's the only

explanation is that already mentioned in these columns, namely, that the company will declare a 20 per cent. dividend next month, making 25 per cent. for the full year. In addition, there are hopes that the Government may square up before long with the Company, in the course of which it is expected that there will be a further substantial sum to come to the Marconi shareholders. Anglo-American deferred has eased off to 15¾. Cuba Submarine shares at 7 are 10s. higher, although a bargain was marked last week at 6¼. There is little doing in the Eastern group. Globe ordinary, with a rise to 16, have come into line with the other members of their family.

Armament shares, together with those of various iron, coal and steel companies, have generally advanced. Babcock & Wilcox remain unchanged at 2 5/16. The rubber share-list is a trifle harder, although the price of the produce is still no better than 11¼d. per lb.

Brazilian Tractions are better at 36, although the preferred eased off to 74½. Canadian General Electrics are 121½ after being higher. The feature in this market is the way in which Mexicans are mounting. Following upon improvements in the previous fortnight, new gains stand to the credit of the issues in the Mexican Light and Power, Mexico Tramways, and the Pachuca Light and Power companies. Vigorous rises have taken place this week in many other Mexicans. A Conference is said to have been arranged at Washington for trying to unravel the difficulties in connection with oil concessions in Mexico. If the various points of contention can be smoothed out, the way will be open for American money to flow into Mexico. Of its readiness to do so, there is no reasonable doubt, but until the diplomatic difficulties that surround the oil question are disposed of, Mexican progress can receive no assistance from American capitalists.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1919.	Dividend 1920.	Price April 19, 1921.	Rise or fall.	Yield. p.c.
Home Electricity Companies.					
Brompton Ordinary	12	12	6	—	£10 0 0
Charing Cross Ordinary	7	8	8¼	—	10 6 6
do. do. do. 4½ Pref.	4½	4½	7¼	+ ¼	7 16 6
Chelsea	4	6	8	—	10 0 0
City of London	13	14	24/6	—	12 0 10
do. do. 6 per cent. Pref.	6	6	17/-	—1/-	7 1 2
County of London	8	8	7⅞	—	10 9 10
do. do. 6 per cent. Pref.	6	6	8	—	7 10 0
Kensington Ordinary	7	9	4¼	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref	6	6	9⅞	—	10 18 2
Metropolitan	6	7	8¼	—	10 15 4
do. 4½ per cent. Pref.	4½	4½	2⅛	—	7 18 2
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	—	2½	—	9 2 10
South Metropolitan Pref.	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5½	—	9 15 2
Telegraphs and Telephones.	1918	1919			
Anglo-Am. Tel. Pref.	6	6	78½xd	—	7 12 10
do. Def.	88/6	1½	15½	— ½	9 10 6
Chile Telephone	8	6	5⅜	—	5 6 8
Cuba Sub. Ord.	7	7	7	+ ¼	10 0 0
Eastern Extension	10	10	16	—	6 5 0
Eastern Tel. Ord.	8	10	160	—	6 5 0
Globe Tel. and T. Ord.	8	10	16	+ ½	6 5 0
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	22	22	—	10 0 0
Indo-European	13	10	30	—	8 6 8
Marconi	25	25	2⅞	+ ⅛	—
Oriental Telephone Ord.	10	12	2¹⁵/₁₆	—	*5 9 7
United R. Plate Tel.	8	8	6¼	—	6 10 8
West India and Panama	1/3	Nil	⅛	—	Nil.
Western Telegraph	8	10	16	—	*6 5 0
Home Rails.	1919	1920			
Central London Ord. Assented	4	4	44½	—	9 0 0
Metropolitan	1½	1½	25	+ ½	6 0 0
do. District	Nil	Nil	11½	—	Nil
Underground Electric Ordinary	Nil	Nil	2	+ ¼	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	4	2	72½	+3	2 15 2
Foreign Trams, &c.	1918	1919			
Anglo-Arg. Trams, First Pref.	Nil	5½	2⅝	—	10 9
do. do. 2nd Pref.	Nil	Nil	3	—	Nil
do. do. 5 % Deb.	5	5	60½	—	8 8 0
Brazil Tractions	Nil	Nil	36	+1	Nil
British Columbia Elec. Ry. Pfce.	5	5	55	—	9 1 10
do. do. Preferred	2½	5	54½	—	*8 14 0
do. do. Deferred	Nil	8	51½	—	*11 17 6
do. do. Deb.	4½	4½	67½	+1	7 7 10
Mexico Trams 5 per cent. Bonds	Nil	Nil	37	+1	Nil
do. 6 per cent. Bonds	Nil	Nil	2⅜	+1	Nil
Mexican Light Common	Nil	Nil	11½	—1	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	64½	+2½	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	2 5/16	— 1/16	6 10 0
British Aluminium Ord.	10	10	16/3xd	—	12 6 2
British Insulated Ord.	12½	15	1⅝	—	9 12 0
Callenders	25	15	1⅞	—	10 18 2
„ 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	18/9	—	14 11 0
Edison-Swan	10	10	10/-	—	—
do. do. 5 per cent. Deb.	5	5	70	—	7 3 10
Electric Construction	10	10	15/9	—	13 14 0
English Electric	—	8	12/6	+1/6	12 16 0
Do. Pref.	—	6	13/-	—	9 4 8
Gen. Elec. Pref.	6½	6½	18/6	+6d.	7 4 5
do. Ord.	10	10	23/3	— 1/16	*8 13 0
Henley	25	15	1 1/16	—	11 8 6
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India Rubber	10	10	1½	—	—
Met.-Vickers Pref.	—	8	13	—	9 3 10
Siemens Ord.	10	10	1 5/16	+ 1/16	*9 15 2
Telegraph Con.	20	20	20	— ½	*5 19 9

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, April 19th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	10d.	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	„	£85	..
a Bisulphide of Carbon	„	..	..
a Borax	„	£34	..
a Copper Sulphate	„	£34	..
a Potash, Chlorate	per lb.	6d.	½d. dec.
a „ Perchlorate	„	10d.	..
a Shellac	per cwt.	£14	10s. dec.
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers	„	£19	£1 dec.
a „ Lump	„	£18	..
a Soda, Chlorate	per lb.	5d.	½d. inc.
a „ Crystals	per ton	£7	..
a Sodium Bichromate, casks	per lb.	1/-	..
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£95 to £300	..
c Brass (rolled metal 2" to 12" basis)	per lb.	11½d.	..
c „ Tubes (solid drawn)	„	1/1½ to 1/2	..
c „ Wire, basis	„	11½d.	..
c Copper Tubes (solid drawn)	„	1/6½	..
c „ Bars (best selected)	per ton	£116	..
c „ Sheet	„	£116	..
c „ Rod	„	£116	..
d „ (Electrolytic) Bars	„	£74	10s. inc.
d „ „ Sheets	„	£145	..
d „ „ Wire Rods	„	£90	10s. inc.
d „ „ H.C. Wire	per lb.	11½	⅛ inc.
f Ebonite Rod	„	2/6	..
f „ Sheet	„	8/-	..
a German Silver Wire	„	2/9	..
h Gutta-percha, fine	„	14/- to 16/-	..
h India-rubber, Para fine	„	10½d.	..
f Iron Pig (Cleveland Warrants)	per ton	Nom.	..
f „ Wire, galv. No. 8, P.O. qual.	„	£40	£5 dec.
g Lead, English Pig	„	£22 10s.	20s. inc.
g Mercury	per bot.	£12 10 to £12 15	..
e Mica (in original cases) small	per lb.	4d. to 4/-	..
e „ „ „ medium	„	5/- to 10/-	..
e „ „ „ large	„	12/6 to 25/- & up	..
p Phosphor Bronze, plain castings	„	1/4 to 1/9	..
p „ „ rolled bars and rods	„	2/1 to 2/6	..
p „ „ rolled strip & sheet	„	2/3 to 2/7	..
d Silicium Bronze Wire	per lb.	1/4	..
r Steel, Magnet, in bars	„	1/8	..
n Tin, Block (English)	per ton	£154 to £155	£4 inc.
n „ Wire, Nos. 1 to 16	per lb.	4/-	..
p White Anti-friction Metals	per ton	£78 to £300	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
j Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
p ——
r W. F. Dennis & Co.

Power-Factor Correction.—A careful study of motor application in an industry with a view to power-factor correction will usually produce rather startling results, said Mr. P. T. Vanderwaart, electrical engineer of the New Jersey Zinc Co., in a paper on "Power-Factor Correction and Its Relation to Plant Operation," read before the Philadelphia Section, Association of Iron and Steel Electrical Engineers. In plant No. 1, a case cited by Mr. Vanderwaart, the horse-power in motors released by such a study was 2,640, while the cost of new motors and reapplication of old ones was $1,400. Sub-station capacity to the value of $600 was also released. The power factor of the maximum demand was raised from 76·5 per cent. to 82·1 per cent. through this study. The saving in energy was not so important, as the weighted average efficiency was only raised from 87·7 per cent. to 88·3 per cent. A study of plant No. 2 produced even better results, the value of motor horse-power released being 3,400, and the cost of making changes $1,800. Sub-station capacity released was valued at $700. Mr. Vanderwaart showed how it was possible to make such surveys of a plant through the use of record systems and a liberal use of instruments. The application and economies of other power-factor correction methods were also brought out.—*Electrical World.*

A Russian Magnetic Iron-Ore Field.—The late Dr. Ernst Leyst, of the University of Moscow, after researches extending over several years, has located with the help of the magnetometer a large field of magnetic iron ore in the Government of Kursk on the Russo-Ukrainian border. The survey has been made over an area of close upon 11,000 sq. miles. There are two ore bodies running parallel to each other at a distance of about 36 miles from each other and each of them about 150 miles long, one of them being 24 miles, the other about 30 miles wide. Dr. Leyst's magnetometric survey has been examined by Dr. Peterson, Professor at the Mining High School in Stockholm, and on behalf of the Swedish Jernkontor by one of their mining engineers, Mr. Nathorst. Both Swedish experts have confirmed the Russian professor's view that a very important iron-ore deposit has been discovered. As soon as the political situation will permit, funds will be provided to make borings and complete the survey.—*Iron and Coal Trades Review.*

THE LABOUR SITUATION AS IT AFFECTS THE ELECTRICITY SUPPLY INDUSTRY.

By T. W. COLE (Joint Secretary, Home Counties Industrial Council).

(*Concluded from page* 458.)

In my last article I pointed out that the tendency of trade unionism in the electricity supply industry was towards industrial unionism, that is, a consolidation of all interests under one trade union organisation. This is, of course, by no means achieved at present.

It was also seen that this tendency of trade unionism fell in with the revolutionary programme of Guild Socialism. Coming to the Industrial Councils, the Whitley Scheme, of course, also falls in line (in respect of the employés' side) with the consolidation of the trade union interests. I mention this merely to indicate the momentous importance of the wise handling of the whole matter in every detail. There is no royal road out of these difficulties; indeed, the electricity supply industry is probably one of the most complex with regard to its labour troubles. Not only are there the factors which we have already enumerated, but even on the employers' side there are dissimilar and sometimes dissentient factors in so far as part of the employers are Municipal Corporations and part are private companies. With regard to the former, certain of the Municipal Corporations are largely directed by labour representatives, whose political and other views may coincide more with the employés than with those of the company employers. Then, also, there is the always impending influence of the Government in the case of disputes which threaten to come to a deadlock. The only interest of the Government is naturally that the public supply should be maintained, which means a tendency towards forcing the issue on grounds of expediency rather than of right or propriety. All this means that in coping with the situation it is finally "brains that must tell." This brings us to the last consideration, the Whitley Councils. It might be said at once that despite the occasional creaking of the machinery, the Whitley scheme provides the best hope of dealing with the whole situation satisfactorily. There is, for instance, in the first place, practically complete machinery for dealing with every question that can occur; secondly, no better scheme can be devised by which the two sides are brought into closer touch. Both parties meet, as it were, on common ground, which is a fundamental necessity of any bona-fide *rapprochement*.

The Whitley Councils were, in fact, organised just at the right time, and the present orderly state of the industry, from a labour point of view, is due, one might say, entirely to their operation. Further, in view of the evolving changes in trade unionism and their possible social consequences, as indicated in the previous article, the Whitley Councils promise to play an even more indispensable part in the future. The fact is apparent that the increasingly effective organisation and consolidation of the trade union movement, to say nothing of its possible expansion, must be met with a correspondingly powerful organisation such as the Whitley Councils. Only in this way can all the potent influences be directed towards the common good. In this connection one important fact is often lost sight of, and that is that there is no such thing as any "final settlement" of industrial problems. Industrial questions are only one aspect of a huge mass of rapidly evolving social questions. To look upon the Whitley Councils, therefore, as in any way courts of periodical arbitrations over differences, is to take a very inadequate view. Their real function is to enable capital and labour to meet, and to make the constant readjustments that are needed by this perpetual evolution.

Among all the complexities of the labour situation there is at least one step which stands out clearly, and that is to strengthen and develop the Whitley scheme to the fullest possible extent, and to ensure that the best brains of the industry are enlisted in its service. In this connection it must be remembered that the Whitley scheme is certainly still incomplete in the direction of Works Committees. The present machinery, namely, the National Council and District Councils, does not bring the employers and employés directly into touch. This is reserved for the Works Committees in each undertaking; such committees form, as it were, the lowest of the three tiers which properly compose the Whitley scheme. There is every prospect, however, that such Works Committees will shortly be formed, since the National Council at present has under consideration the constitution of such committees, and will doubtless be issuing its recommendations in the near future. When such Works Committees are established in the various undertakings, not only will the machinery of the Whitley scheme be so much nearer completion, but an opportunity will be afforded for the influence of the employers to be brought directly on the employés. By this I mean that the employers will have every chance of seeing that the employés understand their opinions on any industrial or other subject which is pressing at the moment. At present employers often have diametrically opposite views to those which are being pressed on the employé from one or another quarter, but they have no adequate opportunity of putting these forward on, as it were, neutral ground. With Works Committees, however, every question which in any way affects the industry can quite properly be included as pertinent for discussion. No one ought to ask more if the old Latin motto is right—*magna est veritas et prevalebit*. As a matter of fact, these words might be taken as the assumed basis of the whole Whitley scheme. The scheme is, in fact, nothing more than a working-out of the suggestion that employers and employed should sit down facing each other and, whatever the subject may be, talk it out. In other words, the Whitley idea is to stake everything on brains, right, or moral weight (a corollary to which is that the side which picks these qualities best should carry the day). This indirectly brings back the question of revolutionary propaganda taking place in the industry, which, in so far as it actually affects industry, is a matter of immediate concern to employers. Whatever may be any immediate practical steps that are taken, it is the general weight and soundness of opinion which tells in the long run. The strength of a great deal of revolutionary socialism lies in its carefully thought-out principles, and the general way in which it is consistently formulated. Being an entirely theoretical scheme, it has naturally in this an advantage over the present-day practical system of economics which has grown up, as it were, as an organism. The fact that capitalism is, so to speak, in possession has resulted in its supporters taking rather too much for granted. Like everything else, it is called upon nowadays to defend its title. It must justify itself on moral, social, and economic grounds, or else sooner or later it must inevitably yield place. It is far too much assumed by both sides that the position of capitalism depends upon "might being right." I mentioned Mr. Hartley Withers's book, "The Case for Capitalism," to a socialist friend one day, and he rejoined: "But it *has* no case!" Now this is the attitude which is too often unconsciously assumed even on the capitalist side, and if revolutionary socialism is not to gain ground, the capitalist supporter must not only first of all be convinced himself that capitalism has a "case," but must know exactly what that case is, and the principles on which it is based. It is obviously useless to deplore a workman being a revolutionary socialist if that is the only system which has been put to him as embodying the best, proper, economic, and moral principles. The problem, therefore, resolves itself into, first,

formulating principles; and secondly, putting them forward for the adequate consideration of everybody concerned.

That there are further modifications necessary to the capitalist system as now in vogue goes without saying. That such agencies as Whitley Councils, if properly guided, may do much towards bringing about, or at least emphasising, these required changes, seems more than likely. Above all, clear, serious thinking is necessary. Finally, it must be constantly borne in mind that the test of any social organisation is its utility to the community. Applying this to capitalism, Mr. Hartley Withers's dictum might be quoted: "The test of an economic system is its success in providing us with a good world to live in." Such are the grounds on which propaganda must be based to be effective.

EXTRA-HIGH-PRESSURE CABLES AT BIRMINGHAM.

There is at present being laid in the City of Birmingham a three-core cable for the transmission of electricity at a pressure of 33,000 volts, under the Beard-Hunter system of automatic protection, the total length of the cable being about 10 miles. Two cables run through the City from the new Nechells generating station to the generating station at Summer Lane, and one cable is laid from this station to a substation at Bourneville, where the pressure will be stepped down to supply the surrounding area at 5,500 volts.

We give an illustration of the cable (fig. 1), which consists of three conductors, each of 0.2 sq. in. sectional area, paper insulated; the cable is lead sheathed and steel wire armoured, water-proofed and laid direct in the ground.

Three-core compensated pilot cables, for use with the Beard-Hunter automatic protective system, are laid in the same trenches, four pairs of telephone cores being provided in these cables for communication between the different stations.

Messrs. W. T. Henley's Telegraph Works Co., Ltd., have manufactured all the cables, and this firm is carrying out the laying and jointing. The joints are not of the usual lead-sleeve type, but are made with gun-metal sleeves plumbed direct on to the lead sheathing of the cable.

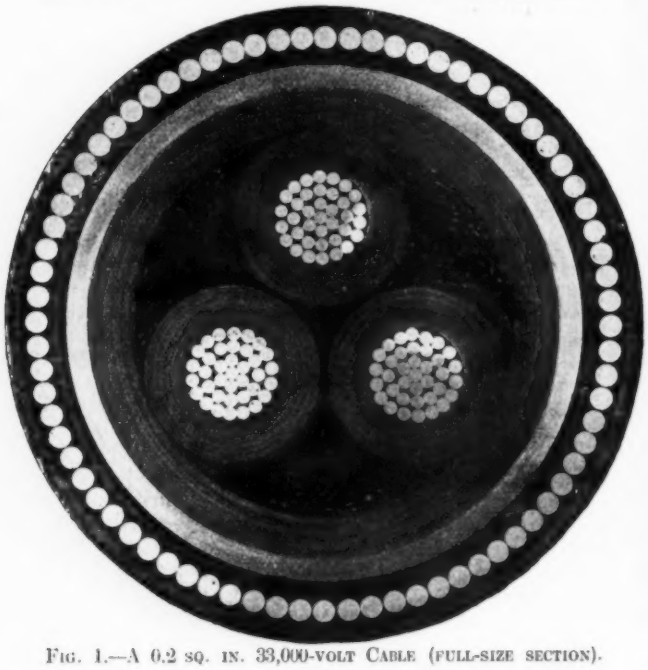


Fig. 1.—A 0.2 sq. in. 33,000-volt Cable (full-size section).

The cables are laid in the footway where possible, but where the footway is too congested, they are laid in the roadway. The extra-high-pressure, 3-core cables are laid in the trenches 18 inches apart, to counteract any possible heating effect, and the pilots and a thirty-pair telephone cable are laid between them. Fig. 2 shows the cables being laid.

After being laid, the e.h.p. cables will be tested at 90,000 volts d.c., and the portable apparatus for this test will be supplied by Messrs. Henley's. The apparatus which will be used is the "Delon," which is light in weight and of small capacity for such very high pressure.

At the time of writing the greater part of the cable has been laid, *i.e.*, between Nechells and Summer Lane, and the work has been very successfully carried out.

THERMIONIC AMPLIFIERS.

(*Abstract of Lecture delivered at* Newcastle-on-Tyne.)

Mr. J. R. Beard, chairman of the Centre, presided at a lecture on February 28th on the above subject, which was delivered to the members of the North-Eastern Centre of the Institution of Electrical Engineers by Mr. W. D. Owen, who, after briefly dealing with the basic principles of the thermionic valve, said it was important to study the characteristics of the valve in its simplest form, because the deductions drawn therefrom applied also to three- and four-electrode valves, which were revolutionising many branches of the electrical industry. By plotting plate current against plate potential a curve was obtained, half of which obeyed an exponential law, and the other half suggested the introduction of a limiting factor. From a series of such curves plotted with different filament temperatures, it became evident that the limitation of current was reached when all the electrons emitted by the filament per unit of time were attracted by the plate, in which case no further increment in plate potential could produce a greater thermionic current. Immediately the temperature of the filament was increased the emissions of electrons became more copious, and the current consequently greater. Another limiting factor operating was the space charge due to the cloud of free electrons in the immediate vicinity of the incandescent filament repelling their more recently freed neighbours back on to the filament. To overcome that space charge limitation it was necessary to increase the plate potential, and thereby accelerate the stream of electrons across the space.

It was thus evident that the successful operation of any thermionic tube depended upon the correct adjustment of both filament temperature and plate potential. Those explanations applied only to perfectly exhausted tubes in which the electrons were free to move without encountering any gas molecules, and the present day "hard" tubes were of that description. The presence of gas even in small quantities, modified the phenomena considerably, especially when the potential was high enough to move the electrons with sufficient velocity to disrupt any gaseous atoms in their path, thus liberating fresh electrons and positive ions, which moved towards the plate and the filament respectively, causing a considerable increase in plate current. The introduction of one or more auxiliary electrodes to enable the electron stream to be controlled by some independent source would seem, in retrospect, to be the next logical step in the development of the valve. Unfortunately, the valve was another of the many British inventions which had attained their consummation

Fig. 2.—View of Cable Trench.

abroad. The speaker mentioned the simplest case of one control electrode situated either inside or outside the tube, but capable of exercising an electrostatic influence upon the electron as it left the filament. The fact of supreme importance was that a potential variation of unit value on the auxiliary electrode produced a plate-current variation such as could only be brought about by a very much greater variation in the plate potential; therein lay the secret of the tube's amplifying properties.

The lecturer referred to the amplification factor, and then spoke of the three-electrode valve, pointing out that one of its interesting applications might be described as that of a potential balance, or rather a potential lever, an arrangement for measuring high voltages. The positive pole of the supply to be measured was connected to the plate of the valve through a galvanometer or milliammeter, and the potential of the grid was varied until no current passed, then the product of the grid voltage and the amplification factor was the required voltage. Theoretically it should be possible to modify the arrangement so that h.p. a.c. could be measured on the same principle, but as the method necessitated a potential divider capable of withstanding the full potential across its extremities, it was not likely to be considered as anything but an interesting speculation. The static method of measuring the amplification factor was not so satisfactory as the dynamic method. The plate and the grid batteries were connected to the extremities of a variable resistance which, by means of a slider connected to the negative end of the filament, was divided into two sections R_1 and R_2. An alternating e.m.f. was also applied as in a Wheatstone bridge. When the filament was incandescent there would be a current flowing in the plate circuit, and that current would vary about its normal value as a result of the alternating e.m.f.'s on the grid, but the plate would be subject to simultaneous variations of the e.m.f.'s 180 deg. out of phase with those affecting the grid. By adjusting the resistances so that the drop across R_1 was equal to the drop across R_2, there would be no sound in the telephones, because there would then be no alternating component in the plate circuit.

The thermionic value had made possible many wireless devices, to say nothing of wireless telephony, and the suggestion was made that it would be even more extensively applied if its limitations were carefully studied when its possibilities in some new directions were being tried out. The lecturer suggested that it might be supposed that the impulse to be amplified followed the sine law, and that it was desired to reproduce those sinusoidal variations faithfully in all respects other than amplitude. That could be done only within the limits of the straight portion of the curve. If the amplitude of the e.m.f. impressed upon the grid were sufficient to take the plate current beyond the upper and lower limits of that straight portion then distortion would result, and if a point on either the upper or the lower bend were chosen as the normal working point, half a cycle would be amplified and the other suppressed. That was a very valuable property in wireless telegraphy, as the valve then rectified the incoming signal for detection and amplified it at the same time. The substitution of a three-electrode valve functioning as a detector-amplifier for a two-electrode Fleming valve would sometimes transform weak unreadable signals into surprisingly loud ones.

The lecturer demonstrated the use of a three-electrode valve applied to wireless telegraphy, the messages transmitted from the Horsea station being picked up. He added that in practice it was seldom necessary or advisable to go beyond six or seven stages of amplification, because, in the first place, sufficient magnification could be obtained for all practical purposes with very few valves, and in the second place, it became more and more difficult to control successfully a multi-staged amplifier as the number of stages was increased, owing to the tendency to interoscillate and set up howling noises. Moreover, parasitic effects would all be magnified in like manner. Beyond four stages it was generally possible to use an electro-mechanical relay, by means of which any desired recording instrument could be operated. The lecturer concluded by alluding to the application of the thermionic valve to the frame aerial, and described the latter. He said that it was quite conceivable that the ubiquitous three-electrode valve might eventually be supplanted by a multi-electrode valve, in which each electrode would have some well defined function, all working together harmoniously to produce the desired effects.

THE ENGLISH ELECTRIC IMPULSE TURBINE.

For a number of reasons the impulse type of turbine has found favour in the eyes of engineers and those putting down new generating stations. This type allows ample clearance between the moving blades and all stationary parts, since the steam pressure in each of the stages is the same on each side of the disks. This feature adds to the safety and reliability of the machine, as compared with the reaction type which involves very fine clearances. Further, the only appreciable end thrust on the rotor is that due to the surface friction of the steam against the moving blades, and this can be dealt with by a thrust block of comparatively small dimensions. The impulse turbine requires fewer stages to deal with a given range of steam expansion, permitting a short and compact design.

The English Electric Co., Ltd., is now in a position to manufacture turbo-electric sets with capacities ranging from 250 kW to 30,000 kW, although none of the largest size have been produced yet. These machines are of very sound construction, and some details may prove of interest to our readers. The rotor shaft, upon which the disks carrying the impulse blading are mounted, is produced from a solid steel forging, rough turned, annealed and re-annealed between various stages of its manufacture, and finally ground to gauge. The shaft is accurately balanced before the disks are fitted. The latter are produced from solid steel forgings, and, as in the case of the shaft, are freed from internal stresses by repeated annealing. The disks are of a section to reduce to a minimum the stresses in the metal at the

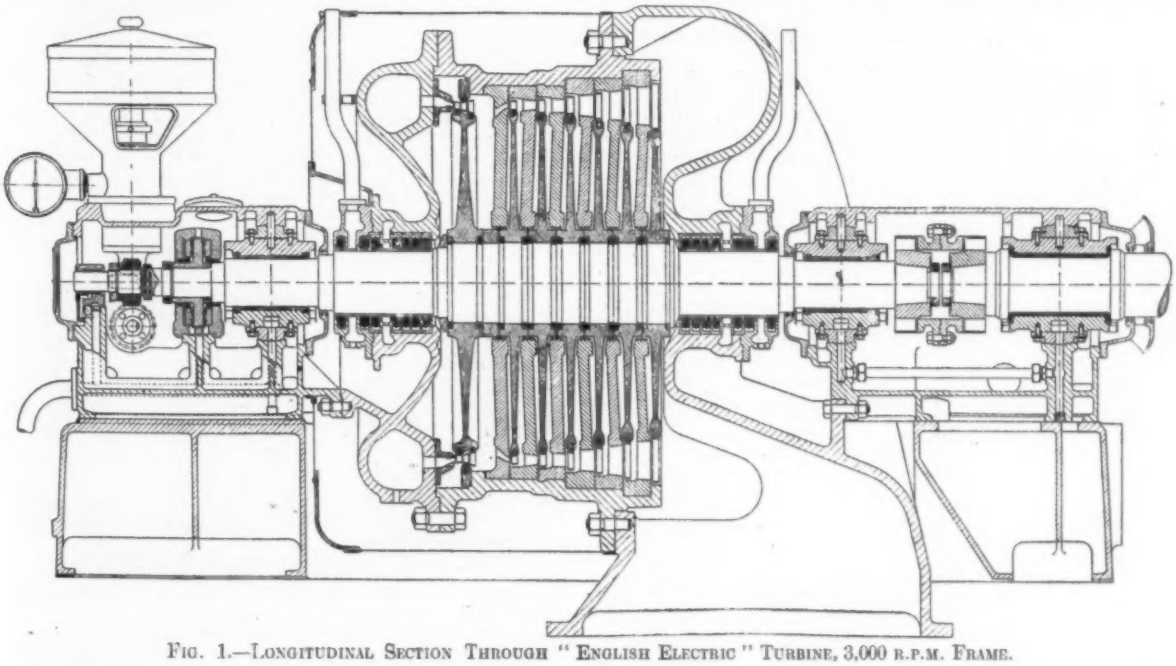


Fig. 1.—Longitudinal Section Through "English Electric" Turbine, 3,000 r.p.m. Frame.

hubs; they are securely mounted on the shaft by means of supporting rings which are keyed into grooves in the shaft. The wheel hub does not actually touch the shaft, a feature which renders removal easy. The points of support are kept at the outer edges of the hub, thus avoiding contact at the centre of the disk where the maximum stretching due to rotation occurs. The moving blades are produced from solid nickel steel bar (fig. 2), and are machined to gauge, and finally polished to reduce frictional losses and liability to erosion. The blade roots, which are of "T" section, fit into corresponding grooves in the periphery of the disk, the blades

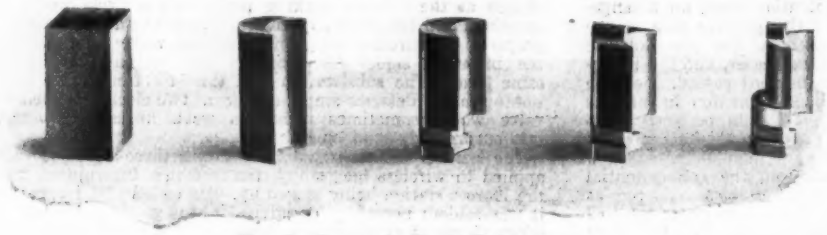


Fig. 2.—Stages in Blade Production.

being inserted through openings, which are securely closed by wedge-shaped locking pieces. Correct spacing is usually obtained by means of distance pieces forming an integral part of the blade (fig. 3), but in some cases these distance pieces are separate parts. The blades are shrouded with special steel strips, tangs being machined at the ends of the blades to provide a means of attachment. These tangs are inserted through slots in the shrouding, and are riveted over.

The glands at both ends of the turbine are of the carbon ring type, consisting of a series of graphitic carbon rings, in three segments, held closely round the shaft by means of garter springs, a space being left between two rings inside the gland, which is supplied with sufficient steam at atmospheric pressure to form a seal. The possibility of air leakage to the condenser is thus obviated.

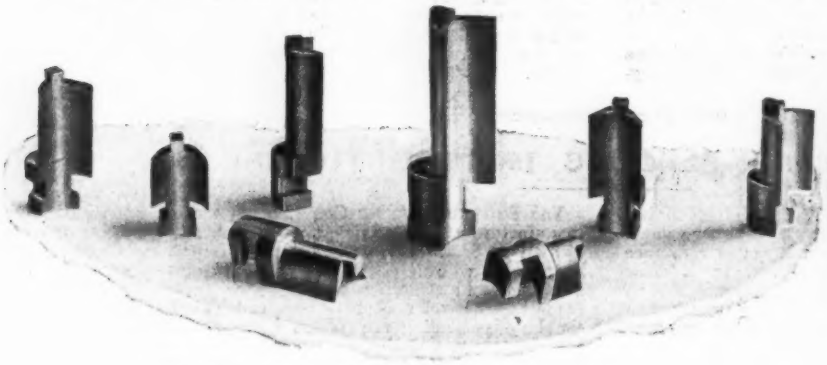


Fig. 3.—Types of Blade, Showing Distance Pieces.

The position of the rotor is maintained by a Michell type thrust block in which a single thrust sleeve, carried by and rotating with the shaft, is held in register by means of stationary elements in the form of inclined pads arranged radially in the fixed portion of the thrust block. These pads, which are supplied with a continuous stream of oil, provide a practically frictionless bearing, as there is always a film of oil between their inclined surfaces and the thrust sleeve. The thrust block is provided with means for close longitudinal adjustment, in order that the position of the rotor and the blade clearances may be fixed before the turbine is put into commission; when the adjustment has been made the block is secured in position by a special locking device.

As regards the stationary part of the turbine, the casing of the high-pressure end is of cast steel capable of withstanding the high pressures and temperatures of the steam before its expansion through the first series of nozzles. The low-pressure portion is of close-grained cast iron. The complete casing is divided on the horizontal centre line, and the top half may be lifted without breaking any pipe joints or dismantling the nozzle control and governing gear, thus giving free access for the examination or removal of the rotor. The steam end bearing pedestal, which carries also the thrust block, is connected to the turbine casing, and is designed with freedom to slide in an axial direction over a steel feather in the bedplate, and thus to follow the expansion of the casing.

The nozzles for the first expansion are carried in segmental castings which are bolted to the cast steel cover at the high-pressure end of the turbine casing. Steam passages of the predetermined form are obtained by means of shaped partitions of suitable alloy cast in the nozzle plate. The nozzles for the remaining stages are formed round the peripheries of the diaphragms in a similar manner.

The diaphragms are constructed of cast iron or steel, and are slightly dished in shape to stand rigid against the varying pressures exerted by the steam during changes of load when the turbine is in operation. For convenience in erecting and dismantling, the diaphragms are made in halves with a horizontal joint, the top halves being held in position in the cover by means of locking screws. The joints between the diaphragms are held in place and made steam-tight by the use of bronze keys which engage both halves. The sealing of the central openings in the diaphragms, through which the shaft passes, is effected by means of labyrinth packing glands formed by soft copper strips, of knife-edge section, which are caulked into parallel grooves so that the edges point outwards and practically touch the shaft. Should touching actually occur, the thin edges of the copper strips will be pressed back to a close running fit round the shaft without risk of damage to the machine.

In operation the turbine is controlled by a powerful vertical governor of the totally enclosed centrifugal type. The governor weights are freely supported on the vertical arms of bell crank levers, and are held in position by compression springs. When the turbine is operated the radial motion of the weights is directly transmitted to the governor sleeve, which communicates with a floating lever. The last in turn operates a small pilot valve controlling the admission of oil under pressure to the top or bottom of the oil relay cylinder. Thus a drop in speed is indicated at once by a downward movement of the sleeve, which, by altering the position of the pilot valve, allows oil to flow under the relay piston, and lifts the main throttle valve until the turbine speed has been brought to the correct level. The reverse action takes place if the speed rises above normal. A speed adjusting gear is fitted to the turbine by which the speed may be varied 5 per cent. on either side of the normal while the machine is running. This gear is useful for adjusting the frequency when bringing alternators into step, and may be arranged for control either from the starting platform or from the switchboard.

Fig. 4.—Emergency Governor Ring.

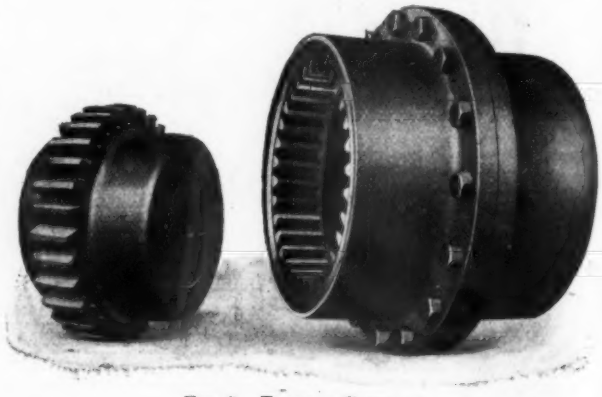


Fig. 5.—Toothed Coupling.

Every turbine is fitted with an emergency governor as a safeguard against the possibility of damage to the machine, should the main governor gear fail for any reason, allowing the speed to rise to a dangerous point. This governor consists of an unbalanced ring (fig. 4) mounted concentrically on the

turbine shaft next to the thrust block, and held in position by means of a powerful compression spring. In the event of the turbine speed exceeding a predetermined maximum, the compression of the spring is overcome by the centrifugal force due to the unbalanced weight, and the ring takes up a limiting position eccentric to the shaft. This causes contact with a trigger which trips the valve mechanism, thus closing simultaneously the combined emergency and stop valve and the main governor valve, shutting off completely the supply of steam to the turbine. The trigger is arranged so that it may be tripped by hand, if necessary.

Oil under pressure, both for the lubrication of the bearings and for the operation of the main governor gear, is provided automatically by a small rotary pump, which is driven through worm gears from the turbine shaft.

Flexible couplings of the tooth or claw type are employed to connect the turbine and the driven shaft. The coupling is carried inside the exhaust end bearing pedestal, and consists of toothed steel sleeves (fig. 5), which fit over and are securely keyed to the ends of the two adjacent shafts, and an outer muff with corresponding internal teeth or slots which encloses the sleeves.

In addition to the standard high-pressure turbines, the English Electric Co. has developed special frames for turbines of the back-pressure, mixed-pressure, low-pressure, and reducing types. The standard frames are arranged so that they are capable of simple modification in detail to meet specially the conditions and requirements of a particular installation.

The foregoing particulars and illustrations are derived from a handsome brochure recently issued by the company.

RECENT DEVELOPMENTS IN TURBINE PRACTICE.

By K. BAUMANN.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from p. 475.*)

Part IV.—Maximum Output at Given Speed.

The most important of the outlet losses are the leaving losses which it has been proposed to decrease by adding to the last row of moving blades a diffuser which converts the leaving velocity into pressure energy, but the increase in output which can thus be obtained from a given area of moving blades is very problematical, and the only effective method of reducing the leaving losses is to provide additional blade area for the last row of moving blades.

The blade area can be increased without increasing the stresses by providing blades, the cross-sectional area of which increases towards the root. The maximum increase is obtained by tapering the blade towards the root in such a way that the stress in the tapered portion is constant. For an increase of 50 per cent. in the blade area, it is necessary to increase the cross-sectional area 65 per cent. and, to double the blade area, by 172 per cent. The increase in cross-sectional area can be obtained by increasing the thickness of the blade, commencing with a thickness at the tip of the blade to be fixed mainly from considerations of strength of rivets required to hold the shrouding. The maximum thickness at the root is limited by the condition that the passage left between the blades must be such that the steam can pass without undue throttling. The blade area permissible for a given stress may be obtained either with a large mean diameter and a relatively short blade, or with a small mean diameter and a long blade. In the first case, the disk becomes relatively large and thin, and the danger of disk vibration must be faced. By adopting long blades, disks of small diameter can be made sufficiently rigid to prevent vibration, and, if the support of the blade is rigid, the possibility of blade vibration is greatly minimised. For these reasons a fairly large ratio h/D is preferable; the figure preferred by the author is $h/D = 1/3.5$.

The loss in efficiency resulting from the use of long blades is very small, and, considering that only the last few rows are affected, it is certainly not worth while running the additional risks connected with large disks, which for reasons of costs are not usually made of sufficient strength to prevent dangerous vibration. In any case, this slight difference in efficiency can be compensated for by providing a slightly larger leaving area.

To obtain the highest possible efficiency with long blades it is desirable to vary the inlet angle of the blade slightly, and there is little additional cost involved in doing so. To prevent the vibration of long blades it is good practice to provide intermediate lugs, which form a complete circle when the blades are assembled. With relatively long blades the fixing of the blade on the disk is the real limiting factor, owing to the fact that the root of the blade becomes relatively thin.

In the G.E. turbine (35,000 kW, 1,500 r.p.m.) installed at the North-West Station in Chicago, the blade area of the last row of blades is 73.3 sq. ft., and the stress in a blade of uniform cross-sectional area is 13.6 tons per sq. in. The bending stress in this blade would increase this stress by at least 20 per cent., but, owing to the increase in cross-sectional area possible with this parallel blade, the stress would be reduced in the ratio of 1.45 to 1.0, and the resulting stress is, therefore, about 11.3 tons as compared with 6.5 tons per sq. in. obtained in multi-exhaust turbines of similar capacities. The difficulties which are experienced in connection with these American machines, however, fully justify the more conservative policy which has been made possible by the use of the multi-exhaust principle.

The fact that in the American machines steel of higher physical qualities may have been used does not materially affect the position, as it is very risky to take full advantage of such properties, having in mind that these higher properties are generally accompanied by increased brittleness which may actually result in decreased safety. Heat treatment by quenching turbine disks of 8 ft. diameter to obtain an elastic limit (limit of proportionality) of 24.5 tons per sq. in. is very doubtful procedure, and it is not safe to assume that the treated disks will be free from internal shrinkage stresses.

It has become standard practice in water turbines to compare rotors on the basis of their capacity for dealing with water at a given head and speed, or, in other words, their capacity for producing power by means of what has been termed "the specific speed."

The author reverts to the original practice of introducing into his formula the volume, as this gives a more rational basis for comparing prime movers with driven machines.

His formula contains the simple relation between the specific speed and the dimension, velocity and peripheral speed ratios, and indicates to the designer all the steps he has to take to increase the speed of a machine. The established formula merely indicates to the estimator the approximate speed of a machine for given conditions, *i.e.*, for a given head and quantity. By means of his formula he compares runners of all types of turbo machines on a rational basis.

The advantages which are claimed to be possible with very high peripheral speeds for the last stage are not realised in actual practice. For this reason the author makes the comparison, so far as steam turbines are concerned, on the basis of the leaving velocity, showing that the capacity of a turbine increases as the square of the peripheral speed only for a given ratio h/D.

In 1912, the general practice was a more or less correctly-shaped exhaust casing without any attempt to guide the steam from the last row of exhaust blades to the exhaust port, which was generally of a circular shape, and the steam had to be distributed over the condenser surface by means of deflector plates. The circular exhaust port was usually kept as small as possible and was partially covered by the turbine cylinder, which overhung into the turbine exhaust. The flow of steam was thereby unduly throttled, and in some cases a drop in absolute pressure of as much as 2 in. occurred between the turbine blades and the condenser.

Even turbines quite recently constructed are incorrectly designed in this respect. For instance, if 50 per cent. of the exhaust port is covered by the turbine cylinder extending into the turbine casing, 50 per cent. of the total exhaust area is rendered ineffective, and the losses are consequently four times larger than with an exhaust properly arranged.

In figs. 6 and 7 (last issue) exhausts are shown in which the steam is directed by means of simple baffles from the last row of blades to the condenser surface in such a manner that the path of the steam is simple and short. Eddy losses are reduced to a minimum, and the steam is uniformly distributed over the whole condenser surface.

The demand for large and efficient turbines for large power stations has brought in its wake the various problems connected with the development of an efficient exhaust end for large turbines working at high vacuum, and the various solutions which have been put forward with a view to reducing the leaving losses to a minimum may be summarised as follows:—

(*a*) By designing a turbine for a lower speed (r.p.m.) any desired blade area can be obtained. Owing to the large decrease in speed usually necessary (*i.e.*, from 3,000 to 1,500 r.p.m. or from 1,500 to 1,000 r.p.m.) this solution is very costly, since it increases the cost per kilowatt of turbine capacity. Moreover, it has an adverse effect on the turbine efficiency.

(*b*) By increasing the length of the blades and the mean diameter, the increase which can be obtained to-day is 50 per cent. greater than that which was obtainable in 1912. Larger increases are difficult to obtain unless stresses are increased at the same time, and as a result of recent experience the present tendency is rather towards lower stresses and higher factors of safety.

(*c*) By adopting the double-flow exhaust principle the capacity of the machine at a given speed can be practically doubled. However, in order to meet critical speed requirements, it is necessary to adopt the two-cylinder design. It increases the cost of the turbine and the buildings out of proportion to the gain in economy due to decreased leaving losses.

The author contends that the multi-exhaust construction introduced by the Metropolitan-Vickers Electrical Co. meets the conditions, and the principle is best explained by means of fig. 17. The steam passes through the h.p. end of the turbine in the usual way until it reaches the special diaphragm D, where it is divided into two parts by the annular division ring E in the diaphragm. Passing through the outer annulus

F, the steam is expanded to condenser pressure, the shape of the diaphragm blades and that of the co-operating row of moving blades at this part being suitably proportioned. In the inner annulus G, the steam passes without appreciable expansion through suitably formed guide blades. Opposite G is the inner portion of the row of moving blades H, shaped in such a way that the stresses due to the centrifugal force are within the limits fixed by the material, the passages left between the blades being such as to pass the maximum quantity of steam with the smallest drop in pressure. The shape most suitable for this purpose is that of a blade with nearly 100 per cent. reaction, as shown in the diagram.

The steam then reaches the diaphragm J, which also has two distinct annular parts, the outer part K being suitably shaped to expand the steam to condenser pressure, and the inner part L to pass the steam on without appreciable expansion

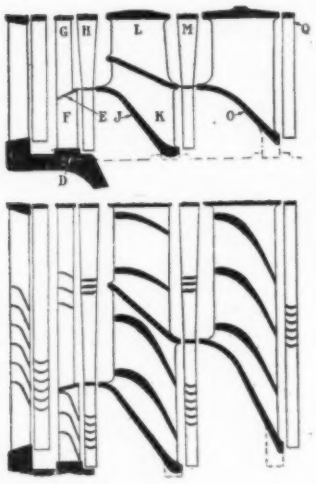
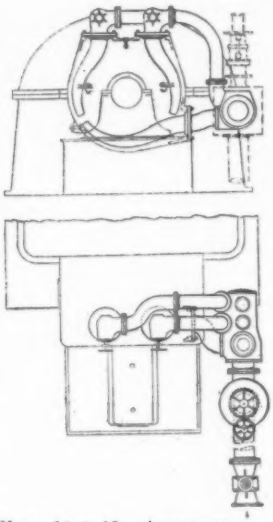


Fig. 17.—Multi-exhaust Turbine Diagram.



Figs. 18 & 19.—Arrangement of Nozzle Boxes.

through suitably-shaped moving blades M to another diaphragm O, where the steam is expanded finally to condenser pressure over the full lengths of the blades Q. Due to the difference in pressure existing in the inner and outer annular passages, a small leakage occurs through the clearance spaces between the guide blades and the corresponding moving blades. This leakage is of quite a minor order, having regard to the large volume of steam dealt with at this part of the turbine.

With this construction it is possible to increase the leaving area of the machine in the ratio of 1 to 1.6 with one additional row of exhaust blades, in the ratio of 1 to 2.2 with two and of 1 to 2.7 with three additional rows. The output of the machine can, therefore, be increased over a considerable range without the use of the two-cylinder construction. Adding to this increase the increase possible by increasing the widths of the blade towards the root, we find that if 5,000 kW is the maximum output for a single-flow 3,000-r.p.m. turbine designed for a vacuum of 29 in. and having parallel blades and a given leaving loss, the corresponding output obtainable from a modern multi-exhaust type turbine having the same leaving loss and factor of safety is 20,000 kW.

In the multi-exhaust turbine the steam is divided into two separate flows only when it has become impossible to deal with the whole of it in a single row of blades. This is not the case in the ordinary types of double-flow turbines. On account of the fact that in a multi-exhaust turbine the steam quantity flowing through the high-pressure stages is much larger than usual, the efficiency of these stages is considerably higher than those of the corresponding stages of previous turbine designs, because the leakage, disk friction and gland losses, &c., are inversely proportional to the output. With the increased outputs possible with the multi-exhaust turbine, it is possible with Rateau turbines to adopt full admission, even for the first row of blades, and special nozzle boxes have been designed to this end.

Turbines built in two separate portions consisting of high- and l.p. elements, the former running at a higher speed than the latter, increase the cost and complicate the running of the plant. In the manufacture of the multi-exhaust type of turbine it is possible to derive considerable advantages which are not obtainable with other designs. It is possible to construct different multi-exhaust turbine frames for relative exhaust capacities of 1, 1.6, 2.2, and 2.7 on the same mean diameter and with the same length and type of blades. It is also possible to use the same set of patterns for moulding the turbine cylinders on all four frames. Thus, for instance, it was possible to build the turbines illustrated in figs. 6 and 7, pp. 473 and 474, on the same set of patterns, a distance piece having an axial length of 2 ft. being necessary to obtain the pattern for the latter frame from that of the former.

During the period under review, the floor space for turbines per 1,000 kW economical capacity has been reduced from roughly 40 to below 20 sq. ft., and the weight from 14 to below 7 tons. For large sets consisting of turbine and alternator the floor space per 1,000 kW economical capacity has been reduced from over 60 to below 40 sq. ft., and the weight from over 20 to below 15 tons. The total height of a turbine of 25,000-kW economical capacity with a condenser of 40,000 sq. ft. can be made less than 35 ft. by bolting the condenser directly to the turbine. It is practicable to make the higher-speed turbine with a smaller weight per kW capacity than the larger turbine. Present practice would indicate that the weight of the smaller machine would be about 10 per cent. smaller per kW capacity than that of the larger turbine. On the other hand, the manufacturing costs are about 20 per cent. higher per ton on the smaller machine and, consequently, the cost per kilowatt of the smaller machine would be about 10 per cent. higher than that of the larger low-speed turbine. This difference is, however, very small considering that the output must be increased four times to obtain a decrease in the cost per kilowatt of 10 per cent. On the whole there would be very little difference between the two cases as regards efficiency. Actually, however, the clearances are slightly larger in proportion on the high-speed machine and, consequently, the efficiency of this machine is reduced. As a rough guide, this difference in efficiency may be taken as being 2 per cent. As far as the efficiency is concerned, a turbine of 10,000-kW capacity running at 3,000 r.p.m. would be equivalent to a turbine of 20,000-kW capacity running at 1,500 r.p.m.

Part V.—Governing.

The use of oil relays for the operation of the governor valves is now universal for all large turbines. The principal disadvantage of throttle governing as compared with nozzle cut-out governing is due, not so much to the fact that at light loads the former is less efficient than the latter, but to the necessity in the case of throttle governing of by-passing h.p. steam to an intermediate stage in order to obtain loads greater than the economical load. Intermediate stages to which h.p. steam is occasionally admitted must be designed to stand the high pressures and temperatures as if they were h.p. stages.

The conditions under which these intermediate stages have to operate are in reality much more severe than those to which the initial h.p. stages are subjected.

The drop in temperature in the initial and in the by-pass stages for normal and maximum loads is much easier where nozzle governing is employed, and the variations of temperature with load in the first and second stages, besides being

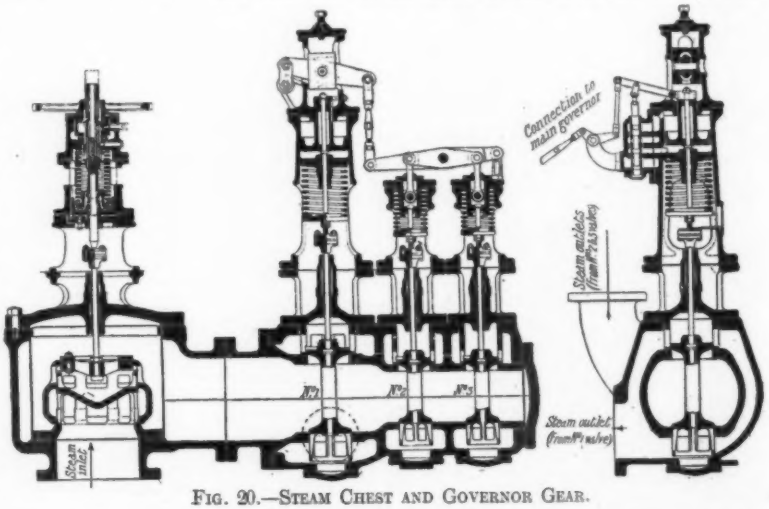


Fig. 20.—Steam Chest and Governor Gear.

smaller in magnitude, are less sudden than those which take place with throttle governing. Owing to the practice for steam conditions tending towards higher pressures and temperatures these facts become of great importance, no matter whether the admission and overload valves are automatically or hand-operated. It is interesting to note that the practice adopted by the General Electric Co. during the period under review is exactly opposed to that which would follow from a consideration of the phenomena described above.

Most large turbines are required to give loads beyond the economical load automatically, and, in the author's opinion, all commercial needs can satisfactorily be met by the use of

three automatic valves, with the addition of probably one or two hand valves to be used for emergency conditions.

Figs. 18 and 19 show an arrangement of nozzles and steam valves and the allocation of loads to each valve and nozzle group. The only parts which are subjected to full steam pressure and temperature are the steam chests and the nozzle boxes. The steam chest and the governor gear are shown in fig. 20. The body of the steam chest consists of an inner and an outer pipe. The inner pipe to which steam is supplied from the main stop valve is provided with three valves, which admit the steam to three compartments formed within the steam belt between the inner and the outer pipes. Each of the compartments in turn communicates with a group of nozzles. The three governor valves are actuated by means of oil pressure under the control of relay mechanism fitted to governor valve No. 1. As the load exceeds that which valve No. 1 is designed to carry when fully opened, the spindle of this valve continues to move upwards, carrying with it a lever pivoted at one end and attached at the other end by means of a short vertical adjustable link to one end of a second lever, the other end of which is pivoted at a fixed point above governor valve No. 3. This lever moves in the same plane as the lever situated above valve No. 1, and carries with it a floating lever, which is connected at its extremities to governor valves Nos. 2 and 3. The springs which close valves Nos. 2 and 3 are so adjusted that, for an increasing load, valve No. 3 remains closed until valve No. 2 is fully opened, and for a decreasing load valve No. 2 does not begin to close before valve No. 3 is fully closed. In like manner valve No. 1 does not begin to close on a decrease in load until valve No. 2 is fully closed.

Part VI.—Recent Steam Consumption Guarantees and Test Results.

In order to assess the economic value of various turbines it is necessary to reduce their thermodynamic efficiencies to a common basis by applying appropriate corrections in respect of certain controlling features which enable us, for comparison purposes, to reduce the thermodynamic efficiencies of turbines to a common standard basis in respect of steam and vacuum conditions. In order to obtain a comparison on a wider basis, *i.e.*, on the basis of the economic value of turbines, it is necessary to take into consideration corrections in respect of the output-speed characteristic and price, and in order to illustrate the application of the above-mentioned correction factors for reducing a turbine to a standard basis for purposes of comparison, the author works out an example on the basis of the published test results of a cross-compound steam turbine installed at the 74th Street Station at New York by the Westinghouse Electric & Manufacturing Co., Ltd. The maximum continuous rating of the machine is 30,000 kW and its economical rating 25,000 kW, the speed of the h.p. turbine being 1,500 r.p.m. and that of the l.p. turbine 750 r.p.m. The author shows that the economic value of this turbine is equivalent to that of a single-cylinder machine of a capacity of 20,000 kW and a speed of 1,500 r.p.m., the efficiency of which when designed for standard conditions would be 74.06 per cent. In order to illustrate the use of the corrections outlined, certain published steam-consumption guarantees have been analysed and corrected in the manner proposed, and it is to be regretted that only one test result on a large turbine has been published during the period under review with the necessary details to enable the actual performance to be judged.

Part VII.—Operation Experience.

The trend of development towards larger capacities at a given speed necessitated, in the case of single-flow turbines, an increase in the peripheral speed of the last wheels with a consequent increase in stresses. The difficulties which have been experienced, however, were generally not directly due to this increase in stresses, but to the increased tendency of the various parts to vibrate. These difficulties have become of the greatest importance owing to the great losses which have been incurred as a result of the various accidents which have taken place. It is the author's considered opinion that turbine development has arrived at the most critical stage in the history of the steam turbine, and a review of the difficulties experienced, together with a full and frank discussion between turbine users and manufacturers, of the means whereby these difficulties may be overcome, will be in the interest of all, and will facilitate further turbine development generally. The principal difficulties which have been experienced are reported in detail by the author, who says that considerable difficulties have been experienced due to distortion of the rotor and stator causing excessive rubbing. Unless large turbines are carefully warmed up so as to ensure a uniform temperature all round the cylinder and rotor, distortion is likely to cause rubbing. The uniform heating up of large low-speed turbines is much more difficult than that of small high-speed turbines, and to facilitate uniform heating up the rotor should, during the warming-up operation, be kept turning round at a low speed—say, 10 per cent. of the normal speed.

The difficulties can be minimised considerably by arranging the parts likely to rub independent of the shaft itself, so that the heat will take some time before reaching the shaft and, when it does so, will be more uniformly distributed all round the shaft. Thin sleeves fitting on the shaft are beneficial, but to be effective a space should be arranged or the sleeve should be of such thickness that it will distribute the heat uniformly all round the shaft. Another solution introduced by the General Electric Co. is dummy strips on the rotor, the strips being thin and relatively high. In case of rubbing, the heat will be generated on the tips of the strips, and as the cooling surface of the strips is relatively large, the heat will be absorbed by the surrounding steam before it is transmitted to the shaft through the thin strips. It is reported that these strips work quite satisfactorily, but they have the disadvantage that they cannot be replaced without taking the rotor disks off the shaft.

Trouble has occurred, particularly in connection with reaction turbines, directly due to the distortion of the turbine casing caused by the stresses resulting from the expansion and contraction of the steam piping, and difficulties have been experienced from the relatively weak support provided for the turbine bearing at the exhaust end. When the turbine was put under vacuum, the bearing support dropped considerably, thus throwing the rotor out of line.

The deflection of diaphragms may be due to two different causes:—

(*a*) The difference in pressure in front of and behind the diaphragm. In this case the deflection increases with the load on the machine, and may become larger than the axial clearance between the diaphragm and the turbine wheel, causing violent rubbing. The complete wrecking of the 35,000-kW turbine at Boston, U.S.A., was due to this cause. The accident took place when, due to a breakdown of another machine on the system, the large unit was called upon to supply the additional load, to which the governor promptly responded by causing the opening of the by-pass valve. The rubbing between the diaphragm and the disk was so intense that it caused the welding of the diaphragm to the disk. The diaphragm consequently started revolving with the rotor until the two halves were thrown off, bursting the turbine casing.

The actual deflection of a diaphragm composed of two portions, viz., the stationary blade portion and the remainder of the diaphragm, is the resultant of the deflection of each portion, and is very difficult to determine by calculation, and past experience has shown that the diaphragms which have been used were in many cases much too weak.

(*b*) The diaphragm usually fits into a groove in the turbine cylinder with a given radial clearance. At no load, or when the turbine is running non-condensing, the temperature of the steam flowing through the last rows of blades is considerably higher than when the turbine is running under load. If the load is decreased suddenly, or if the turbine changes over to atmosphere, the last diaphragms will heat up much more quickly than the more massive exhaust casing. The diaphragms will consequently expand at a greater rate than the casing and, if the clearances are not sufficient, the diaphragms may distort in an axial direction under the pressure exerted by the casing in a radial direction. This will cause rubbing between diaphragm and rotor, with disastrous consequences unless the turbine is immediately shut down.

Considerable difficulties have been experienced during the last eight years due to the cracking of turbine disks, and it has been possible to avoid serious accidents by inspecting the machine carefully as soon as increased vibration became evident and removing the faulty disk before an actual burst occurred. In another case, however, the turbine disk actually burst, primarily due to fatigue fracture which generally takes considerable time to develop. This fatigue fracture is caused by the vibration of the turbine disk giving rise to considerable vibratory stresses being superimposed on the static stresses due to centrifugal force and uneven distribution of temperature. With reasonably sound material, excessive static stresses would simply cause an elongation of the material without causing a fracture. High local static stresses, however, such as those which occur at balance holes, keyways with sharp corners, sharp edges or rough machining work in any part of the disk, or owing to faults in the material, are contributory causes. The vibration may be of the umbrella-shape, or the segmental type with two or more nodal diameters. The former is likely to be set up by some axial disturbance of the shaft such as may result from an inaccuracy of the thrust bearing or flexible coupling. The latter may be caused by the uneven distribution of the admission of the steam over the periphery of the turbine wheel, such as may occur with partial admission, or even with small inaccuracies in the stationary blades such as usually exist near the horizontal joint of the diaphragm. In such a case the nodal diameters rotate at the same speed as the disk, but in a direction opposed to the direction of rotation of the disk. They are, therefore, stationary in space, and the disk assumes a deformed shape stationary in space. There is evidence, however, that dangerous vibrations also occur in cases where the nodal diameters do not rotate relatively to the disk, or only at a speed lower than the running speed. Such vibrations may be set up by a slight vibration of the machine resulting from a badly balanced rotor. These various types of vibrations may exist at the same time, and greatly complicate the problem of predetermining the natural frequency of vibration by calculation, and a good deal of research work will be necessary to clear up the situation.

Owing to the difficulties which have been experienced, due directly or indirectly to the use of high peripheral speeds, the tendency towards the employment of such high peripheral speeds has received a definite check. During the war the difficulties were not primarily due to faulty material; if vibration had not existed, the fault in the material would not have resulted in the fracture of the disk. It is proved, however,

that in some instances the faulty material did accelerate the fracture. The disk may easily pass an over-speed test of short duration, even if it is faulty; moreover, it is quite probable that the test itself may cause further local weakening. A good indication of correct rigidity can be obtained by supporting one end of the stationary rotor on a part of another machine which can be rotated at various speeds up to the maximum running speed for which the supported rotor is designed. If any parts of the stationary rotor vibrate in synchronism with the running machine, there is a possibility of similar vibration occurring when the rotor is run.

In impulse turbines the disk is heated or cooled by the steam leaking past the diaphragm glands, and it is thus kept at a fairly uniform temperature except for the lag occurring in the heating of the more massive hub as compared with the time required to heat the relatively thinner rim. This lag may be considerable with large disks, but will be much smaller with disks at the exhaust end such as are shown in figs. 6 and 7 (last issue). This point is of considerable importance for the l.p. disks, where the largest temperature changes occur, because at very light loads the steam at the exhaust end may become superheated owing to the windage losses due to the long l.p. blades, and also because when changing over to atmosphere the temperature may suddenly be raised from 100 to considerably over 200 deg. F.

In some types of reaction turbines disks are used for the l.p. end. The spaces between such disks are filled with stagnant steam, and when changes of load occur the difference between the temperatures at the rim and the hub may cause warping or vibration of the disks unless the spaces between the disks are ventilated by steam at approximately the same temperature as the steam flowing through the blades.

There have been difficulties due to blades being stressed too highly, and blades which are fixed to the turbine disks by means of a T-root have been particularly vulnerable, owing to the very high local stresses caused by the sharp corners which are associated with this type of fastening. The principal difficulties here are again due to the possibility of vibration, which may be set up by synchronous vibration of the turbine disk, or by excessive vibration of the machine due to unsatisfactory dynamic balance of the rotor, or to unsatisfactory working of the thrust bearing or coupling, or finally to a synchronous vibration of the blades themselves. The cure of the disease depends on its cause.

If the feed water is kept reasonably free from corrosive matter, particularly from CO_2 and oxygen, and if the turbine is kept free from moisture when standing, corrosion can be practically eliminated. The feed water should not be exposed to atmosphere at any part of its cycle. To ensure the turbine being in dry condition when standing, the air pump should be kept running for some time after shutting down, and the steam space should be open to atmosphere to lead away any steam which may leak past the stop valve. It has been found beneficial to inject a small quantity of kerosene into the steam entering the turbine, which forms a coating on the blades and affords protection against corrosion.

Erosion can be diminished considerably by draining the water from every stage so that it does not come into contact with the moving blades. It is also essential to prevent the accumulation of water in pockets and bends in the steam piping, valves and turbine casing.

During the period under review, bearing speeds have increased from 60 to over 120 ft. per second, and bearing pressures from 60 to over 120 lb. per sq. in.

The temperature of the oil should not exceed 160 deg. F. in any part of the system. There is no necessity for water cooling, and this additional complication should be abolished even with large high-speed bearings.

The success of large turbines depends to a great extent on their proper treatment during operation. The principal object in starting up must be to obtain temperature conditions as close as possible to those existing when the turbine is running under load, *i.e.*, the h.p. end must be heated up whilst the warming-up of the exhaust end should not be started until a considerable vacuum has been obtained, say, 20 in. (Hg). When a vacuum of 25 in. has been reached, the turbine should be started by passing a puff of steam through the governor valve, and should be kept running at about 10 per cent. of the normal speed for about 15 minutes, after which the speed may be increased to full at the rate of not more than 10 per cent. of the full-load speed in one minute. When the turbine is brought to full speed, in order to effect a gradual stabilisation in temperature, the load should be increased slowly at the rate of not more than 10 per cent. of full load in one minute.

The above particulars apply to large 1,500-r.p.m. turbines. For 3,000-r.p.m. machines, the time allowed for warming-up can be considerably reduced.

If vibration occurs during starting up, reduce the speed at once until vibration disappears, and keep running at the reduced speed for some time, after which the speed may again be increased. Keep the turbine and the generator in good running balance; if vibration increases for no apparent reason, shut the turbine down and examine the rotors.

Electrical Imports of Siam.—The imports of electrical goods and apparatus into Siam reached a value in 1919-20 of £121 790, as compared with only £86,563 in 1918-19.

NOTES FROM CANADA.

(From Our Special Correspondent.)

In the Canadian House of Commons recently there was a debate on the subject of the canalisation of the St. Lawrence river, and it is reported that there was little opposition to the scheme except on grounds of probable cost. This matter has been the subject of exhaustive inquiry by the International Joint Commission during the past year. This Commission has held numerous sittings in very many cities and towns in Canada and the United States, and has heard many witnesses for and against the project; as has been mentioned before in these notes, most of the opposition comes from New York State (chiefly on account of the existence of the Erie Barge Canal and the large expenditures which have been made on it), from the railway companies, and from Montreal.

To assist the International Joint Commission in its labours Canada and the United States each appointed an engineer to jointly investigate the whole scheme, and to report to the Commission; these engineers are supposed to have their report ready in the very near future, and probably within a short time afterwards the report of the Commission itself will be issued.

This report will be of very great interest to many sections of the community, as the scheme is one of far-reaching importance, and if carried out and successful will profoundly affect Canada and the Western States of the Union.

Primarily, the St. Lawrence canalisation scheme is one effecting navigation, for it is intended to enable ocean-going vessels to go right from the Atlantic to the western end of Lake Superior. The picture opened up to the imagination by such a project is one of possible tremendous expansion of Canadian trade, of the growth of towns and villages in the far interior of the country, of the creation of new lake ports, and the increased prosperity of existing ones, and of the rapid extension of the already vast grain-growing areas of the western Provinces.

The opponents of the scheme, of course, take a lugubrious view, and foresee vast sums of money expended on something which they are convinced will never bring in any return, hence, instead of increasing prosperity, they prophesy a burden of debt under which the country will languish for years.

The above is somewhat of a diversion, so to return it may be pointed out that those who favour the proposal to make Canada's greatest river a canal claim that the water power which could, by suitable engineering works, be developed would pay by far the greater portion, if not the whole, of the cost of the entire scheme, and doubtless, if the cost were not too heavy, so that power might be made available at reasonable rates, there would be much truth in this claim. The furnishing of approximately 4,000,000 h.p. to a region abounding in natural resources of all kinds—agriculture, mines, forests, fisheries, game, &c., should, if rates were competitive with those in other parts of the world, result in wonderful development throughout the territory served in Canada and the United States (it must be remembered that of the 4,000,000 h.p. mentioned about one-quarter would belong to the United States), especially when combined with navigational facilities communicating with a very large part of both countries as well as the outside world.

REVIEWS.

Motor and Dynamo Control. By W. S. Ibbetson, B.Sc., A.M.I.E.E. Pp. viii+476; 174 figs. London: E. & F. N. Spon, Ltd. Price 21s. net.

This book has been specially written for engineers who are engaged in the operation and control of all types of electrical machinery.

It covers a wide range of subjects; the first chapter is on "General Principles," while the last one deals with "Lubricating Oils and Mechanical Hints." The reviewer has searched in vain for any point with the slightest claim to freshness or originality.

In the so-called theoretical portions of the work extremely elementary applications of Ohm's law and the relations between mechanical and electrical units are given. The formulæ are given in every possible way, the author evidently being of the opinion that his readers will be incapable of carrying out the simplest algebraic transformation. The practical hints are on the same level as the theoretical work. In some cases the hints given are misleading. For example, when dealing with the drying-out of machines, the author recommends that "Immediately any smoke is seen, or excessive smell of charred insulation . . . is observed, open the main switch . . ." (p. 197.) This seems rather like locking the stable door after the horse has been stolen. The author might with advantage have recommended the use of thermometers. The instructions regarding paralleling d.c. dynamos (pp. 209 and 273) are inadequate, as the danger of a machine having wrong polarity is not mentioned.

The author seems to think that supermen are required for paralleling alternators (p. 274). The operation is really very

simple, and could be performed by anyone of normal faculties after a few minutes' tuition.

Catalogue information is freely used, the notes on motor converters being a specially glaring example. All the matter and figures on this subject can be found in Messrs. Bruce Peebles's pamphlet, which is itself a reprint of a paper by Mr. Saaler.

In his chapter on "Alternate-current Motors," the author seems to imply that for power purposes 25-cycle supply is better than 60-cycle supply. This view will not be supported by engineers afflicted with 25-cycle systems.

The figures consist of simple line diagrams, and the inevitable manufacturers' stock illustrations. The diagrams are not particularly well executed, and figs. 59 and 60 are poor. The winding diagram given in fig. 17 has a remarkable similarity to that given in Barr's "Direct Current Engineering" (fig. 144).

The English style in the book is hardly what one would expect from an honours graduate. The author seems to have very little use for verbs. One of his sentences(?) is "Easy adjustment of brush rocker, yet secure fixing in any position by bolts easily accessible" (p. 224). This savours of Walt Whitman. On the same page he starts another priceless effort which runs to 87 words; the reviewer was keenly disappointed that the century was not reached. Under "Fault Localisation" there are weary lists of troubles which ought to be self-evident to the merest apprentice. These are also tabulated in the manner of the august American poet.

The book may be useful to the great army of untrained practical men, who are averse to thinking for themselves, but even to them it cannot be of much permanent benefit.

The reviewer has no hesitation in candidly expressing his opinion that any ordinary electrical pocket book is a far better investment than the work under review.—C. W. M.

The Year Book of Wireless Telegraphy and Telephony, 1921. Pp. 1,355, illustrated. London: Wireless Press, Ltd. Price 21s. net.

This, the ninth, edition has been increased to the extent of two hundred pages. Apart from additions to the articles which form, perhaps, the most attractive feature of the work, the standard features have been amplified and extended to bring them into line with recent developments. An addition which is likely to prove of service is a nine-page list of schools and colleges at which wireless telegraph courses are given. The information contained in this list includes details of fees, hours of attendance, and duration of course for schools in many parts of the world.

In the Special Articles Section, the "National Résumés" now include notes on the progress in 1920 in Canada, China and Spain. The Canadian notes are contributed by Prof. A. S. Eve, and it is stated that the most important radio-telephonic event of the year was associated with the visit of the Imperial Press Delegation to Canada, when communication was established with the s.s. *Victorian*, which carried the delegates, at a distance of one thousand miles. Mr. F. E. Robinson deals with Chinese progress, which has been very rapid. The Wireless Telephone Signal Corps, officered by Chinese military officers, proved a valuable unit during the 1920 disturbances, when the telegraph and telephone wires were cut. Three 25-kW stations are in course of erection, and in addition to these a factory is being built by the Chinese National Wireless Telegraph Company at Shanghai for the output of wireless apparatus. The remainder of the *résumés* are written by eminent men in their respective national fields and taken together form a valuable record of the forward steps made during the year.

There are four special articles in the present issue; that on "Valve Amplifiers for Shipboard Use" has been re-written by its author, Mr. F. P. Swann. The article which appeared in the last edition discussed the factors which governed the design of the three-valve amplifier; the four electrode valve was then in the embryo state, and it was recognised that the design put forward at that time was only a temporary measure. Since then, however, a great advance has been made, and the description of a four-electrode valve and its circuits is dealt with very fully. The details of the valve are reached through a description of the three-electrode valve and its development, and, by means of the diagrams given, the designs and circuits are not difficult to follow.

Mr. Philip R. Coursey, B.Sc., A.M.I.E.E., in an interesting and useful article, describes "Some Outstanding Problems of Radio Reception, with Particular Reference to Interference." The author details the methods employed to eliminate or minimise tuned and untuned interference from other stations and from natural electrical disturbances or atmospherics. Dealing briefly with alteration of wave-length, not a very practical solution, the author passes on to directive reception and its advantages in connection with the elimination of interference by other stations. The prevention of interruptions by natural phenomena—a much more difficult matter—is discussed, and the means of combating their effects are treated of, including the omission of tuning of the aerial circuits to the signals to be received, so that the natural oscillations set up by the atmospherics will thus be given a different frequency from that of the signal it is desired to receive. The incoming signals, if their decrement is very small, will be able to force an oscillation of their own frequency in the aerial circuit, and thus affect the tuned secondary circuit coupled to the aerial. This coupling must be a weak one, or the atmospherics will impulse the secondary directly. Thus at least a partial separation of signals from the atmospherics is possible. Variations of this arrangement are dealt with, and these are followed by descriptions of limiters as opposed to "eliminators" of the effects of atmospherics. The "Kallirotron" limiter, devised by L. B. Turner, is detailed and illustrated diagrammatically. Several other devices are briefly mentioned, and the whole forms a valuable guide to the solution of interference problems.

"The Radio Compass" is very fully described by Mr. Stuart Ballantine. Commencing with the theory of operation of an ideal compass, the author passes to the modified theory of the compass in its practical form. This is a thoroughly technical article which takes into account an enormous number of factors. The remaining article is a survey, by Prof. G. W. O. Howe, D.Sc., of the "Historical Landmarks in Wireless Invention." Commencing with the experiments of Hertz in 1887, progress is traced step by step, through the inventions of Lodge, Marconi, and many others, to the state of the science and art at the present time.

It is impossible, within any reasonable space, to deal adequately with a work of this nature, but perhaps enough has been said to indicate its worth to all in that ever-widening field which was first opened up such a short time ago.

The Theory of Direct-Current Dynamos and Motors. By John Case, M.A. Pp. xiii+196; 122 figs. Cambridge: W. Heffer & Sons, Ltd. Price 15s. net.

This book, the author states in his preface, is intended to cover the gap usually existing between the work commonly dealt with in specialised books on the design of electrical machines and the work met with in text books on general electrical engineering. The hope is expressed that it will, in particular, be useful to men reading for an honours degree in universities.

The treatment of the subject is essentially from a theoretical point of view, no attempt being made to include an account of constructional details. While agreeing in general with the author, that such information can best be obtained by practical experience, we feel that an ideal book should contain a due proportion both of theory and of practice. Many useful lessons can be taught from work of a more practical character, the interest of the student is more likely to be secured, and an appeal is made to a wider circle of readers.

The greater part of the book is concerned with the theory of the operation of dynamos and motors, special attention being devoted to the consideration of losses and efficiency and to motors for traction. The section dealing with losses and efficiency, which includes a full account of the appropriate methods of testing, may be well commended.

Numerous examples, many of which are taken from university examination papers, are included in the book, some of which are fully worker out and others left as exercises for the reader. Those dealing with characteristic curves of motors and dynamos strike us as being particularly useful and interesting. In a few of the worked examples we find numerical errors, and in others the data might perhaps be improved, but these are matters which will doubtless be set right when the time arrives for a second edition. A list of answers to the unworked examples might, with advantage, be added at the same time.

The book is well printed and the figures are clear, though in a few cases the lettering on them is not quite in line with the text.

Lehrgang der Schaltungsschemata elektrischer Starkstrom-Anlagen. By Dr. J. Teichmuller. Vol. I; Schaltungsschemata für Gleichstromanlagen. Pp. vii+131; 27 plates, 9 figs. Second edition. Munich: R. Oldenbourg. Price 68 M.

The main feature of this publication is the set of lithographic plates, giving diagrams of connections of a wide range of electrical apparatus and installations; these are very clearly printed and easy to trace, although sometimes as many as 20 diagrams appear on one plate. The subjects vary in complexity from the simplest two-wire circuit to very elaborate power-station switchboards, with batteries and boosters, &c.—all for direct current in this volume. Three-wire balancing generator windings of various types are illustrated, the Thury system of transmission finds a place, and examples are given of connections to fulfil special requirements. The last plate is devoted to a pictorial index to the symbols employed in the diagrams.

The text for the most part is directly related to the diagrams, explaining the purpose of these and pointing out possible modifications. A few paragraphs are of a more general nature. The plates are detached from the bound volume, so that they can be studied alongside of the explanatory text without turning pages. The work is certainly useful and, so far as we have tested it, reliable.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

9,844. "Variable speed squirrel cage induction motors and generators." J. C. B. Ingleby. April 4th.
9,857. "Mechanical and electrical railway fog-signalling apparatus." G. A. Farmer, L. J. Coussmaker, and E. A. Campbell. April 4th.
9,858. "Apparatus for indicating approach of trains." E. A. Campbell, L. J. Coussmaker, and G. A. Farmer. April 4th.
9,862. "Continuous flow apparatus for manufacture in solution of pure alkali, &c., by electrolysis." C. G. Vernon. April 4th.
9,874. "Switch and fuse contacts." Callender's Cable & Construction Co., Ltd., and A. E. Wilson. April 4th.
9,877. "Electric burglar alarms." G. Kirk. April 4th.
9,881. "Mounting for trolley poles." V. Spagnuola and M. Urbinati. April 4th.
9,882. "Wind-driven electric generating sets." G. Lambert. April 4th.
9,888. "Sparking plug." M. Prat. April 4th.
9,904. "Adjustable telephone bracket." T. W. Arney. April 4th.
9,909. "Electrically-heated muffle furnaces." Akt.-Ges. Brown, Boveri et Cie. April 4th.
9,910. "Apparatus for suppressing upper harmonic currents in metal vapour rectifiers." Akt.-Ges. Brown, Boveri et Cie. April 4th. (Switzerland, April 10th, 1920.)
9,911. "Apparatus for suppressing upper waves in the direct-current circuit of metal vapour rectifiers." Akt.-Ges. Brown, Boveri et Cie. April 4th. (Switzerland, May 15th, 1920.)
9,913. "Installation apparatus for wireless telegraphy." C. S. F. Mellor. April 4th.
9,919. "Electron discharging device." British Thomson-Houston Co., Ltd. April 4th. (United States, October 22nd, 1920.)
9,929. "High-resistance conductors." British Thomson-Houston Co., Ltd., and H. W. Taylor. April 4th.
9,921. "Current collecting devices for electrically propelled vehicles." British Thomson-Houston Co., Ltd., and C. McCready. April 4th.
9,926. "Decorative electric devices." H. H. Berry and C. A. Painton. April 4th.
9,933. "Galvanic batteries." G. Oldham and J. Oldham. April 4th.
9,934. "Pocket electric lamps." G. Oldham and J. Oldham. April 4th.
9,951. "Cut-outs." Metallurgique Electrique. April 4th. (France, September 6th, 1920.)
9,952. "Automatic circuit breakers." Metallurgique Electrique. April 4th. (France, September 6th, 1920.)
9,958. "Electro-mechanical lamps." P. Blot-Garnier and G. Chevalier. April 4th.
9,959. "Ships' telegraphs, &c." W. Clark (C. P. Clark). April 4th.
9,984. "Railway signalling devices." Ateliers de Constructions Electriques de Charleroi Soc. Anon. April 5th. (Belgium, January 3rd.)
10,005. "Sparking plugs." L. S. Clarke. April 5th.
10,038. "High-frequency duplex signalling system." Western Electric Co., Ltd. (Western Electric Co., Inc.). April 5th.
10,051. "Plug connections for electric circuits." J. Hall & Co. and G. F. Ostins. April 5th.
10,057. "Liquid electric controller." R. F. Baerlocher. April 5th.
10,058. "Drum type controller." R. F. Baerlocher. April 5th.
10,065. "Electric relays." E. A. Sperry. April 5th. (United States, November 13th, 1914.)
10,081. "Injection devices for internal combustion engines." J. Romeyn. April 6th.
10,098. "Electric lamp for motor cars and cycles." L. E. H. Hill. April 6th.
10,119. "Short-circuiting electrical devices." C. F. Killar. April 3th.
10,133. "Attachment for automobile dynamos for combining the action of lighting and starting." S. Gussin. April 6th.
10,140. "Apparatus for magnetising steel for permanent magnets." A. T. Scorey. April 6th.
10,141. "Electrical switchboards." Metropolitan-Vickers Electrical Co., Ltd. April 6th. (United States, April 23rd, 1920.)
10,168. "Electro-refining glass furnace." W. G. Clark and L. N. Bruner. April 6th. (United States, April 6th, 1920.)
10,172. "Illumination control systems." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). April 6th.
10,178. "Means for cooling dynamo machines." R. F. Baerlocher. April 6th.
10,179. "Apparatus for registering telephone calls." E. H. Kinnard. April 6th.
10,181. "High-frequency telephone systems." Ges. für Drahtlose Telegraphie. April 6th. (Germany, April 9th, 1920.)
10,183. "Insulated conductors." British Thomson-Houston Co., Ltd. (General Electric Co.). April 6th.
10,178. "Means for cooling dynamo electric machines." R. F. Baerlocher. April 6th.
10,199. "Device for testing sparking plugs." G. Burchell. April 6th.
10,213. "Device for automatically making and breaking an electric circuit with commencement and ceasing of speaking currents, &c." Telegraphon Ges. April 6th. (Germany, August 24th, 1920.)
10,217. "Regulation of high-tension cable systems." A. M. Taylor. April 6th.
10,239. "Sparking plugs." S. P. Shaw. April 7th.
10,241. "Sparking plugs." J. S. Borrington, W. H. Lowth, and Lowth & Smith, Ltd. April 7th.
10,249. "Spring contact members for electric circuits on motor vehicles." E. G. Mottershead. April 7th.
10,261. "Variable rheostats, &c." L. A. Gow. April 7th.
10,265. "Machine for undercutting commutator micas of dynamo-electric machines." G. Flower. April 7th.
10,274. "Telephones." E. A. Laidlaw and Siemens Bros. & Co., Ltd. April 7th.
10,281. "Counting mechanism for telephones." H. J. Carter. April 7th.
10,285. "Teletype machines." E. C. R. Marks (Morkrum Co.). April 7th.
10,324. "Wireless telegraph and telephone systems." H. J. Round. April 7th.
10,326. "Reception of radio signals." Marconi's Wireless Telegraph Co., Ltd. April 7th. (United States, April 14th, 1920.)
10,332. "Electrolytic apparatus." J. T. Niblett. April 8th.
10,341. "Holders for electric lamps, plugs, &c." H. J. Dean-Osgood. April 8th.
10,365. "Electric tumbler switches." G. H. Webb and W. H. Wood. April 8th.
10,372. "Electric and automatic device for egg testing." H. E. Keogh. April 8th.
10,394. "Control of alternating current electric motors." Metropolitan-Vickers Electrical Co., Ltd. April 8th. (United States, June 17th, 1920.)
10,396. "Electro-magnetic machines." G de Holden-Stone. April 8th.
10,398. "Ignition devices for internal combustion engines." A. E. Lamkin. April 8th.
10,399. "Apparatus for regulating phase compensation for asynchronous electric machines." E. C. R. Marks (Siemens-Schuckertwerke). April 8th.
10,403. "Lamps, searchlights, &c." J. G. Smith. April 8th.
10,404. "Commutators." J. E. Calverly and W. E. Highfield. April 8th.
10,416. "Electro-magnetic switches." British Thomson-Houston Co., Ltd. (General Electric Co.). April 8th.
10,417. "Lighting fixtures." British Thomson-Houston Co., Ltd., and F. M. Cocksedge. April 8th.
10,418. "Electron discharge devices." British Thomson-Houston Co., Ltd. and R. C. Clinker. April 8th.
10,433. "Dynamo electric machinery." H. E. Joel. April 9th.
10,434. "Combined safety coupling and buffer for colliery trams, &c." R. J. Haddon. April 9th.
10,441. "Electric switches." J. B. Tucker. April 9th.
10,442. "Electric switches." J. B. Tucker. April 9th.
10,462. "Electrical machines." S. B. Morgan. April 9th.
10,472. "Electric lighting systems." F. W. Highfield. April 9th.
10,473. "Vent plugs for electrical accumulators, &c." C. Saunders and Saunders Electrical Co., Ltd. April 9th.
10,478. "Electric voltage regulators." E. C. Wilkins. April 9th.
10,487. "Dynamo electric machines." E. C. Hatcher and T. Rooke. April 9th.
10,498. "Electric conductors." S. G. Frost and J. Erskine-Murray. April 9th.
10,506. "Cartons for storage, &c., of electric lamp bulbs, &c." A. H. Rippon. April 9th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

20,399. "Wireless direction finders." H. J. Round. August 19th, 1919. (160,475.)
22,114. "Pulleys for use with trolley poles of electric tramcars, and for other purposes." G. A. Bishop and R. A. Chadwick. September 9th, 1919. (Cognate application, 9,303/20.) (160,478.)
25,950. "Electric heat radiators." A. F. Berry. October 22nd, 1919. (160,486.)
26,315. "Electrical seam-welding machines." E. Schroder. June 8th, 1918. (Addition to 133/700.) (135,212.)
28,478. "Electrical seam welding machines." E. Schroder. June 12th, 1918. (135,482.)
29,033. "Electric switches." H. F. Westney and British Ever Ready Co., Ltd. November 21st, 1919. (160,497.)
29,296. "Wireless receiving apparatus." C. K. Chandler. November 24th, 1919. (Cognate application, 14,683/20.) (160,502.)
31,617. "Electric welding." O. A. Kenyon. December 17th, 1919. (160,518.)
31,788. "Combined electrical and mechanical drive for a vehicle equipped with steam turbines, polyphase generators, and asynchronous motors." Maschinfabrik Oerlikon. October 30th, 1919. (153,270.)
31,899. "Electric furnaces." British Thomson-Houston Co., Ltd., H. C. Hastings, and N. Laycock. December 19th, 1919. (160,529.)
31,920. "Electric switchboards." A. H. Midgley and C. A. Vandervell and Co., Ltd. December 19th, 1919. (160,531.)
31,948. "Ignition devices for internal combustion engines." F. A. Smith. December 19th, 1919. (Addition to 142,197.) (160,535.)
32,066. "Automatically operated electric switches for controlling electric motors." J. A. Hirst and P. S. Brook. December 22nd, 1919. (160,547.)
32,132. "Manufacture of plates or sheets by electro-deposition." S. O. Cowper-Coles. December 22nd, 1919. (160,554.)
32,371. "Electric arc lamps." F. R. Boardman, R. V. Boardman, and F. Boardman. December 24th, 1919. (160,569.)
32,372. "Reflectors for electric arc and other lamps." F. R. Boardman, R. V. Boardman, and F. Boardman. December 24th, 1919. (160,570.)
32,375. "Electric arc lamps." F. R. Boardman, R. V. Boardman, and F. Boardman. December 24th, 1919. (160,571.)
32,879. "Electric cigar lighters and similar devices." Quain Electric Co., Ltd., and J. R. Spink. December 31st, 1919. (160,582.)

1920.

209. "Alternating current track circuits for railway signalling." Automatic Telephone Manufacturing Co., Ltd., and P. N. Roseby. January 3rd, 1920. (160,589.)
467. "Electric accumulators." J. H. Green. January 6th, 1920. (160,595.)
707. "Electrical switchgear." W. A. Coates, G. E. Gittins, D. R. Davies, and Metropolitan-Vickers Electric Co., Ltd. January 8th, 1920. (160,603.)
1,415. "Means for facilitating the timing of electric ignition apparatus of internal combustion engines." F. C. Ewart. January 16th, 1920. (160,609.)
1,591. "Electric condensers." British Thomson-Houston Co., Ltd., A. P. Young, and H. L. Durrant. January 17th, 1920. (160,611.)
1,660. "Elastic fluid turbines." British Thomson-Houston Co., Ltd. (General Electric Co.). January 19th, 1920. (160,616.)
4,012. "Electric lamp." G. A. Fennimore. February 10th, 1920. (160,637.)
4,592. "Flame proof boxes for switches, fuses, and similar electrical fittings." W. T. Henley's Telegraph Works Co., Ltd., and G. Gregoire. February 14th, 1920. (160,641.)
5,432. "Electrically heated utensil." E. C. R. Marks (Landers, Frary and Clark). February 23rd, 1920. (160,645.)
7,709. "Railway electric track-circuits." W. R. Sykes Interlocking Signal Co., Ltd., and R. W. Tarrant. March 10th, 1920. (160,663.)
8,244. "Electric motors for starting internal combustion engines." R. Bosch Akt.-Ges. May 5th, 1919. (142,795.)
9,822. "Flexible pendant electric light fittings." W. Broadbent. April 8th, 1920. (160,686.)
10,612. "Spark plugs." R. R. Hill. April 5th, 1916. (141,740.)
11,150. "Terminal electrical connections suitable for the sparking plugs of internal combustion engines." M. L. Williams. December 10th, 1919. (Divided application No. 151,349.) (160,375.)
11,624. "Spark plug." J. M. McHernan. April 27th, 1920. (160,693.)
12,506. "Telephone exchange systems." Western Electric Co., Ltd. August 17th, 1916. (142,851.)
12,943. "Electrical connectors." Western Electric Co. August 10th, 1918. (143,220.)
14,721. "Electric fuses." G. Austin. May 31st, 1920. (160,383.)
16,399. "Snap-action switches for electric lighting circuits." R. Alkan. August 19th, 1919. (149,940.)
16,680. "Electric contact makers and circuits connected therewith for railways and the like." N. P. Roe. June 21st, 1920. (Patent of addition not granted.) (160,388.)
17,348. "Electrolysers." R. Pechkranz. June 27th, 1919. (146,184.)
19,104. "Pneumatically operated electric switches." W. J. Thorrowgood and F. Bushrod. December 30th, 1919. (Divided application on 150,778.) (160,113.)
19,108. "Brush holders of electric dynamos." F. Munz. April 5th, 1919. (147,089.)
20,593. "Controlling system for simultaneously firing a number of guns from a central station." Siemens & Halske Akt.-Ges. April 13th, 1916. (148,771.)
21,389. "Electric induction regulators cooled by forced draught." Akt.-Ges. Brown, Boveri et Cie. July 15th, 1919. (149,284.)
21,628. "Conduit fittings for electric conductors." H. March and W. Newey. July 19th, 1920. (160,711.)
21,855. "Electromagnets." Soc. Anon. Des Etablissements L. Bleriot. July 31st, 1919. (149,342.)
23,375. "Electric motor for driving phonographic and other machines." H. Wade (H. S. Mills). October 22nd, 1919. (Divided application on 154,411.) (160,715.)
23,750. "Pouring channels for electric and other furnaces." D. De Luca. September 2nd, 1919. (Divided application on 150,532.) (159,803.)
28,081. "Apparatus for separating or sorting fragmentary materials by electric conductivity." H. L. A. Schweitzer. October 3rd, 1919. (151,990.)
26,901. "High-frequency electric signalling." Western Electric Co., Ltd. September 29th, 1919. (Addition to 102,503.) (151,923.)
31,516. "Electrical transformers." Metropolitan-Vickers Electrical Co., Ltd. December 10th, 1919. (155,237.)